UTILIZATION OF PANEER WHEY FOR THE PREPARATION OF TOMATO SOUP AND A COMPARATIVE STUDY ON ITS NUTRITIVE VALUE

THESIS

Submitted in Partial fulfilment of the
requirements for the degree of

MASTER OF SCIENCE IN
FOOD SCIENCE AND APPLIED NUTRITION
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BY

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ROLL NO. 236

Dedicated
To my

BELOVED

BROTHER

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CERTIFICATE OF ORIGINAL WORK

This is to certify that the studies conducted by **Miss Jyotika Joseph** during the year 2000-2001 as reported in the present thesis were under my guidance and supervision. The result reported by her are genuine and the script of the thesis has been written by the candidate herself. Her thesis entitled **"Utilization of paneer whey for the preparation of tomato soup and a comparative study on its nutritive value"** is therefore being forwarded for acceptance in partial fulfilment of the requirements for the award of the degree of **Master of Science in Food Science & Applied Nutrition**, Allahabad Agricultural Institute (Deemed University), Allahabad, U.P., India.

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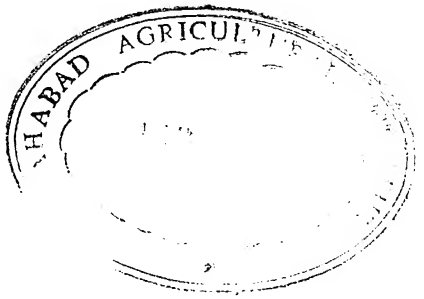

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CERTIFICATE OF ACCEPTANCE OF CHAIRMAN AND MEMBER OF THE EXAMINATION COMMITTEE

This thesis entitled " **Utilization of paneer whey for the preparation of tomato soup and a comparative study on its nutritive value**" prepared and submitted by **Miss Jyotika Joseph** in partial fulfilment of the requirements for the award of the degree of **Master of Science in Food Science and Applied Nutrition** is hereby accepted.

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Date: 24.5.2001

jyotika joseph

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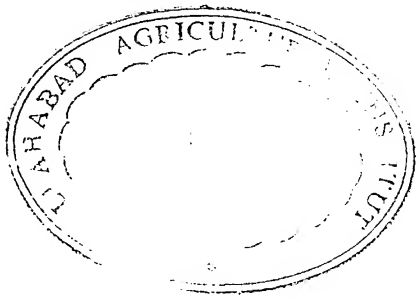

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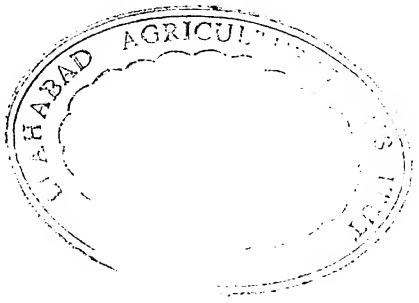

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CHAPTER ---1

INTRODUCTION

INTRODUCTION

Whey is highly nutritious by-product of cheese, paneer chhana and casein industry. It is the fluid portion of milk obtained by coagulation of casein during the manufacture of cheese, paneer and chhana.

It contains about half of the milk solids, most of the lactose, about one fifth of the proteins, most of the vitamins and minerals. The protein present in whey comprises about 50 % β-lactoglobulin, 25 % α-lactalbumin and 25 % of other proteins. Whey protein have very high nutritive profile and are high in essential amino acids, thus a high biological oxygen demand (BOD) of 35,000-45,000 mg O_2 / litre. About 100 litres of whey has polluting strength equivalent to the sewage and at the same time aggravates pollution problems.

Whey solids possesses excellent functional properties, such as solubility, emulsifying power, foaming, water binding capacity and gel formation.

The annual world production of whey is estimated to be over 133 million tonnes, which represents about 5.5 million tonnes of whey solids (**Tinbergen; 1998).**

About 3 million tonnes of whey produced in India containing about 2 lakh tonnes of valuable milk nutrients **(Bhattarcharjee; 1993).**

Whey obtained as by-product in the production of paneer, channa and srikhand, contains about 10 % of total

milk proteins, lactose and minerals. In cheese production about 20 % of total milk proteins, water soluble vitamins and minerals should play a significant role in human as a source of energy, protein, vitamins and micro nutrients **(Jelen; 1978).**

According to **Renner (1983)**, the high nutritional value of whey protein is based on its higher concentration of essential amino acids such as tryptophan, leucine, isoleucine, threonine and lysine than casein. Whey proteins also contain about 2.5 gm of cystine per 100 gm of protein.

100 gm of dried whey supplies approximately 349 calories of energy **(Jelen; 1978).**

Whey constitutes about 80-90 % value of milk used for conversion of chhana, paneer, cheese and casein. It regains about 45-55 % of milk nutrients, lactose, vitamins and minerals.

The absorption of calcium can be considerably improved by inclusion of lactose in diet. The effect is thought to be due, not to lactose itself, but to its metabolic product lactic acid which is formed by microbial action in the intestinal tract, increase the absorption of it and replace the intestinal micro flora (proteolytic and putrefying bacteria to acidophillic flora).

Lactose is described as glucose with delayed action with respect to rise in blood sugar, there is no objection to the use of lactose in the diet of diabetic patients . Quantities of upto 35 to 50 gm of lactose daily spread over the day are

thought to be acceptable **(Bachmonnn et al; 1977 & Kuber et al; 1977).**

Whey proteins have high digestibility due to the coagulation property. Its protein plays an important role in the resistance against intestinal infections, particularly by E.coli. Its bacteriostatic effect is thought to be due to its ability to bind iron and thus inhibit the growth of bacteria which requires iron.

Whey is an excellent beverage base and as it is genuine thirst quenture. Whey drinks are light, refreshing, healthful and nutritious but less acidic than fruit juices. They offer good profit margin.

There have been 21 whey based drinks available in European market. The predominant types are based on fruit juices.

Whey possesses preventive and curative elements and it is especially used to treat wide variety of ailments like arthritis, anemia and liver complaint **(Jelen; 1992)**. These virtues are additional and should be exploited.

At present most of the whey solids, are usually drained off, causing great loss of valuable nutrients and creating problem for environment. It is observed that BOD of whey is very high as compared to domestic sewage which causes 300 mg O_2 / litre (BOD) only.

At recent study by **Durham et al (1997)**, indicating that for treating 5 lakh litres of whey sewage would cost $ 10,000 per day for primary treatment and $1,45,000 for tertiary

treatment. There is an awareness all over the world on the potential utilization of whey primarily because of pollution prevention regulation, economic conditions, fast food habits and future needs to ease the world food shortage **(Hoton; 1995).**

The most logical use of whey is to recycle the whey in food chain again. Thus it transforms the image of whey from unwanted by-product to available raw material for the manufacture of quality material. Whey may be utilized on the basis of following principle:

Principle of utilization of Whey :

Principle of Utilization	Food products
Fermentation	Whey beverages
Concentration	Whey protein concentrates
	Whey based lactose
Drying	Dried whey powder
Coagulated	Ricotia, Mycist, Primist

Indian Dairy industry is looking for new product ideas and technologies to meet the consumer requirements and increase profitability. At this stage product diversification using whey components without much change to the existing infrastructure is quite feasible.

In recent years, processed food products especially ready to serve foods are gaining popularity in global market and this has led to the processing of tomato and mushroom soups etc. Now soups have important role as delicacy and

are part of meals in parties. Various formulated soups have gained popularity because of their nourishing and appetizing qualities have created a new habits in many countries and have been part of meals in parties, all star hotels and Rajdhani trains.

Objectives of present research work:

India has not only made progress in milk production 74.5MT **(Business digest Jan. to Feb.; 1999)**, but it has also emerged as top fruit producer in the world **(FAO;1995).** However, distressing aspect is that as much as 25.30% of the total fruit produced in India get spoiled in the absence of infrastructure for appropriate post harvest technology.

As the traditional foods are being developed into convenient fast food, the idea of getting ready to serve whey based soups, seems to have bright future. Whey's full potentiality should be exploited instead of simply dumping down which is causing water pollution and increase the BOD level.

By making tomato soup from whey and tomato juice, it will enhance nutritive value, profitability, digestibility and overall acceptability of the product simultaneously checking the pollution. The present investigation is done with the following objectives.

1. To study the feasibility of utilizing whey for soup making.
2. To standardize the process of whey tomato soup.
3. To replace whey in place of milk in soup.

4. To study the chemical quality of whey tomato soup.
5. To compare the different aspects of whey tomato soup with commercial tomato soup.
6. Sensory evaluation of whey tomato soup.
7. Economics of whey tomato soup.

Scope and statements of problem:-

In recent years processed food products especially ready to serve foods are gaining popularity in global market. Now soups have played an important role as delicacy and have become part of meals in parties, all star hotels and Rajdhani Express. Various formulated soups and soup powder have gained popularity because of their nourishing and appetizing qualities and have created a new food habits.

Whey is an excellent beverage bases and genuine thirst quencher, nutritious and possesses medicinal properties but treated as waste dairy by-product.

Tomatoes on the other hand have good amount of vitamin C, vitamin A, minerals and having excellent digestibility and palatability.

The present investigation has been done on utilization of whey for the preparation of tomato soups. Whey which is waste by-product of organized and unorganized dairy sector especially large number of sweet shops and restaurants. On the other hand tomato is seasonal and highly perishable vegetable and easily available in low price during peak

season. With a view to utilize the whey and tomato with rapid increase in income of organized and unorganized dairy sector of the country.

On one side it controls the pollution and on the other hand it adds value to the product.

Keeping the above mentioned reasons in mind the present investigation entitled "**Utilization of paneer whey for the preparation of tomato soup and a comparative study on its nutritive value**" was conducted with the following objectives.

1. To study the feasibility of utilizing whey for soup making.
2. To standardize the process of whey tomato soup.
3. To replace whey in place of milk in soup.
4. To study the chemical quality of whey tomato soup.
5. To compare the different aspects of whey tomato soup with commercial tomato soup.
6. Sensory evaluation of whey tomato soup.
7. Economics of whey tomato soup.

The experiments were conducted in the research laboratories of Department of Dairy Technology and Department of Biochemistry, Allahabad Agricultural Institute (Deemed University), Allahabad.

Plan of work:

1. Selection of ingredients.
2. Collection of ingredients.
3. Testing of ingredients.

4. Standardization of the process for the manufacturing of the whey tomato soup.
5. Sensory evaluation of the product.
6. Chemical study of the product.
7. Economics of whey tomato soup preparation.

Chapter ---2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Although lot of work have been made on experimental basis for utilization of paneer whey for the manufacture of certain products, such as acid whey, fermented whey beverages etc, but making whey for tomato soup has not been quoted.

Information covering the different aspects of paneer whey and tomato soup is reviewed in this chapter under the following headings:

2.1.1 Introduction of paneer whey
2.1.2 Production of paneer whey
2.1.3 Composition of paneer whey
2.1.4 Nutritional importance of paneer whey
2.1.5 Therapeutic properties of whey
2.1.6 Problem of disposal of whey
2.1.7 Utilization of whey
2.2 Soup
2.3.1 Botany of tomato
2.3.2 Nutritive and medicinal value of tomato
2.3.3 Use of tomato
2.3.4 Production and cultivation of tomato

2.1.1 INTRODUCTION:-

Whey is the fluid obtained by separating the coagulum from milk , cream and from skim milk **(Whey Product Institute USA; 1973).**

Chhana and paneer whey were obtained during preparation of chhana and paneer respectively **(Soni et al; 1980 and Sachdeva; 1983)**

Whey is a by-product in manufacture of Cheese, Paneer , Chhana and other coagulated milk products .Its composition varies according to type of product from which it is derived. Whey comprises of lactose, protein, fat, mineral, vitamins **(Kennedy; 1985)**.

Whey contains lactose , high quality protein such as β-lactoglobulin, α-lactalbumin, protease, peptone, immunoglobulin, bovine serum, albumin, lactoperoxides and lactoferrin and minerals such as calcium, phosphorus, sodium and potassium, these make up 60% of the mineral components of whey. It also contains significant amount of vitamins such as thiamine (B_1), riboflavin (B_2) , pentothenic acid , folic acid and ascorbic acid (vit.C) . Total solids content of whey varies between 6.5 – 7.5 depending upon the type and source of whey used **(Kulkarni; et al 1987).**

2.1.2 PRODUCTION:

Tinbergen (1988), estimated that the annual world production of whey is over 133 million tonnes.

Bhattacharjee (1993), estimated that about 1000million tonnes of cheese whey in world is drained into gutter, thus resulting in the loss of 50 million tonnes of valuable nutrients.

Shahani K.M et al (1975), points out that in USA the output of whey products for human consumption in production included 411.8 million lb. dried whey , 88.3 million lb. condensed whey , 24.5 million lb. partially delactosed whey and 21.9 million lb partially deminerialised whey.

India's estimated whey production is 1000 million kg and production is likely to increase as multinational companies(MNCs) are setting up their cheese plant in India **(Purunik et al; 1997).**

Khamurai K. and Rajorhia G.S. (1998), informs that about 3 million tonnes of whey is produced in India containing about 2 lakh tonnes of valuable milk nutrients.

Aneja (1997), points out that India at present produces 12 lakh tonnes of chhana per year which results in chhana whey production of about 8 million tonnes .

2.1.3 COMPOSITION :-

Kulkarni et al (1987), point out that it is quite likely that whey from different sources might show variations in its chemical composition due to process and behaviour of the product .

Eckles et al (1951), have reported that cheese whey contains 93.4 % water , 0.35 % fat, 0.88% protien, 4.8% lactose and 0.6 % ash.

Ray and De (1953), reported the composition of paneer / chhana whey of different types of milk as shown in Table No.1

Table No.- 1: Composition of paneer whey

Type of Milk	Whey %	Fat %	Protein %	Lactose %	Ash %
Cow	89.4	0.54	0.46	5.19	0.46
Buffalo	77.5	1.67	0.48	5.89	0.48

Srinivasan and Ananthakrishnan(1964), have reported the composition of different types of whey as shown in Table No.2

Table No.-2: Composition of different types of whey

Types of Whey	Water %	Fat %	Protein %	Lactose %	Ash %	Lactic acid %
Paneer whey	93.7	0.53	0.9	5.1	0.66	0.23
Chhana whey	93.0	0.3	0.9	4.9	0.6	0.2
Cheddar Cheese whey	93.0	0.3	0.9	4.9	0.6	0.2
Acid casein whey	93.0	0.1	1.0	5.1	0.7	0.4

Whittier and Webb (1970), reported the composition of cheese whey and casein whey as shown in Table No. 3

Table No.-3 : Composition of cheese whey and casein whey

Types of whey	Water %	Fat %	Protein %	Lactose %	Ash %
Cheese whey	93.0	4.9	0.9	0.3	0.6
Casein whey	93.4	6.1	1.0	0.1	0.7

Voghra V.R. and Rajorhia G.S. et al (1998), described the mineral composition of whey as shown in Table 4

Table No. - 4 :- Minerals Composition whey

Types of product	Types of milk used	Minerals										
		Ca	Mg	P	Cit.	Na	Cl	K	Cu	Fe	Zn	Total Ash
Chhana	Buffalo	43.47	8.05	41.94	140.75	39.64	64.27	103.27	0.02	0.085	0.095	0.35
	Cow	51.00	9.63	39.44	124.12	42.98	71.8	132.14	0.012	0.082	0.090	0.32
Paneer	Buffalo	54.25	8.75	43.75	153.75	39.00	64.68	103.54	0.017	0.078	0.092	0.40
	Cow	52.00	8.86	45.50	126.56	44.61	115.69	130.54	0.013	0.072	0.59	0.37
Chakka	Buffalo	165.50	14.05	99.37	0.00	38.36	63.38	101.00	0.019	0.065	0.59	0.65
	Cow	113.5	10.75	73.62	0.00	38.36	115.27	130.20	0.019	0.057	0.37	0.52

2.1.4 NUTRITIONAL IMPORTANCE OF WHEY:-

Abdel Solom (1991) and Renner (1983), reported that whey protein have shown higher biological value (104) as against whole egg (100) and casein (77). It also possessed higher PER and NPU than casein. The protein efficiency ratio (PER) of whey protein is 3.6 as against 3.8 (whole egg) and 2.9 (casein) whereas NPU is 94 for whole egg, 76 for casein and 92 for whey proteins.

Forsum (1976), reported that whey proteins have adequate essential amino acids which are easily digestible and are considered to be nutritional and physiologically complete.

Mac Donald (1978) and Nemitz (1977), observed that glucose and galactose the product of hydrolysis of lactose are actively absorbed from intestine into the blood, while almost all other hexoses and pentoses pass into the blood by diffusion since lactose is more slowly absorbed than sucrose it supplies energy for longer periods.

Puranik and Rao (1996), reported the nutritional significance of whey protein itself has very high nutritive value, even higher than protein of egg, which is normally used as standard. β-Lactogloblulin make up approximately 80 % of whey proteins. Whey are rich in essential amino acids containing 53.8 and 52.1 gm of these acids per 100 gm of protein respectively.

Allum (1980), observed that whey nutrients represents a huge quantity of nutritionally rich food. Inspite of its high nutritional quality whey is still of being largely wasted.

Jelen (1978), quoted a reference from Agricultural Handbook USDA about the nutritive value of dried whey and compared it with that of whole wheat flour, which is shown in Table No. 5

Table No.- 5:- Comparison of the nutritive value of dried whey and wheat flour.

Components	Unit / 100 gm of product	Dry whey	Wheat flour
Water	gm	4.5	12.0
Protein	gm	12.5	13.0
Carbohydrate	gm	7.35	71.0
Fat	gm	1.0	2.0
Ash	gm	8.0	1.7
Calcium	mg	6.46	41.0
Thiamine	mg	0.5	0.6
Riboflavin	mg	2.5	0.1
Niacin	mg	0.8	4.3
Food energy	cal	349	333

Clark (1979), describes that in additional whey and modified whey have been utilized as food ingredient in many nutritional programme where whey plays an important role in feeding of malnourished population of developing countries.

Tskittishvili (1988), has recommended whey protein based product for school catering.

2.1.5 THERAPEUTIC PROPERTIES OF WHEY: --

In 460 B.C. Greeks described whey for an assortment of human ailments. In the Middle Ages, whey was recommended by many doctors for varied diseases and by the mid 19th century, whey reached a high point with establishment of over 400 whey houses in Western Europe. Whey possesses preventive, curative ailments and especially used in wide variety of complaints **(Jelen; 1992).**

An early records of the benefits from consumption of whey as food was found in **Hoffmann's (1761)**, " Treatise on the virtues and uses of whey" after 34 pages extorting the medicinal virtues of whey in detail he concluded, " Since therefore it is evident that whey has a good effect in many diseases nothing now remains, but to recommend this noble medicine to other physicians and heartily with that it may restore numbers to health." Thus the whey has been used by the physicians for stomach ailments, chronic diseases of heart and kidneys as well as skin diseases. In 18th and 19th century whey cures a skin disease which was common in various parts of Switzerland, Austria and Germany.

Lactose is described as glucose with delayed action with respect to rise in blood sugar, there are no objections to the use of lactose in the diet of diabetic patients. Quantities of 35-50 gms of lactose daily, spread over the day are

thought to be acceptable. **(Bachmonn et al; 1977, Kube; 1975, Kube et al; 1977).**

Whey was also recommended for uremia, arthritis, liver diseases, anemia and even for tuberculosis in Central Europe **(Pien; 1943).**

2.1.6 PROBLEM IN DISPOSING OF WHEY :-

At present most of the whey solids are usually drained off causing great loss of valuable nutrients and creating problem for environment and population. In the absence of economically viable technology most of the whey is allowed to drain into sewers thereby increasing the BOD load in addition to net loss of valuable food ingredients. It is estimated that about 1000 million tonnes of cheese whey in world is drained into gutter thus resulting loss of valuable nutrients **Bhattacharjee (1993).**

Puranik et al (1997), describes that whey is having high BOD of 35,000-45,000mg O_2/litre and 100 litres of whey polluting strength is equivalent to the sewage thereby aggravating pollution problems.

Khamrui and Rajorhia (1998), has mentioned that biological oxygen demand of whey is very high 35,000 mg O_2 /litre compared to domestic sewage which causes 300mg O_2/litre. A recent study by **Durham et al (1997)**, indicates that treating 5 lakh litres of whey in the sewage would cost $

10,000 per day for primary treatment and $ 1,45,000 for tertiary treatment.

Bandopadhyay et al (1997), observed that dumping of whey amount to an economic loss for the dairy industry as the production of several valuable products like ethanol, single cell protein, lactose, baker's yeast, methane etc. by fermentation of whey.

Gillies (1974), observed those biological oxygen demand (BOD) values for cottage cheese whey ranges from [illegible] raw whey discharged into sewage treatment plant has been calculated to equal to the load imposed by 1,800 people.

Molder et al (1973), estimated that the pollution level of whey is a potential source of water pollution. Fish and aquatic life thrive in water containing at least about 5ppm of Oxygen.

As pointed by **Groves and Graft (1965)**, over 25 % of the cheese factories in America are paying to processors to dispose off whey for them. Only about 2 % whey of the participating cheese factories reported that they were able to sell to farmers. Another 2 % were able to sell their whey to processing plants and 4 % processed whey in their own plants.

The following methods of whey disposal had been suggested by **Trebler and Harding (1947)**

1. Dilution by streams and rivers
2. Returning whey to farmers
3. Disposal as sewage
4. Dumping of whey in abandoned mines and pits
5. Field disposal by spreading as field fertilizers.

Zall (1980), suggested pre-treatment of cheese milk by ultra-filtration to lower the whey output and fermentation of whey to methane and alcohol.

Riddler and Chandler (1974), suggested that treating of whey by using activated sludge trickling filters, aerated lagoons before letting, whey into sewage and irrigation canals.

Knight et al (1972), have suggested the use of *Saccharomyces fragilis yeast,* which utilizes lactose completely and 20-40 % of protein from whey in 8-12 litres with a concurrent BOD decline by 60-80 percent.

2.1.7 UTILIZATION OF WHEY :--

According to **Khamrui (1998)**, Indian dairy industry is looking for new product idea and technologies to meet consumer's requirement and increase profitability. At this stage product diversification using whey components without much change in the existing infrastructure is quite feasible.

Whey can be successfully utilized in baking soup, sauce and filled dairy gel **(Mann; 1991).**

There is an increased awareness all over the world on the potential utilization of whey primarily because of pollution prevention regulations, economic conditions and future needs to ease world food shortage **(Horton; 1995).**

Pre-emergence of whey as **Predergast (1958)**, has recognized an excellent beverage as it is a genuine thirst quencher.

Kravchenko (1988), reported that there are at least twenty-one whey based drink/beverages available in European market.

In U.S.A., bakeries and dairies are the major users of whey, other major user being in blends, prepared dried mixes, candy, chocolates, soup, margarine, meat products. **(Dunkley; 1977).**

Use of whey in the manufacture of soup and gravy mixes, culture media, beverages, whey protein concentrates **(Shahani et al; 1978).**

Reeves (1983), discussed outlets for whey and whey products which includes cheese manufacture, fortified low fat milk and yoghurt with whey protein. Use of whey and whey protein in ice-cream, blending of whey proteins with other non dairy ingredients (including casein) for use in bakery, candy, soup and sauce.

A cholesterol-free egg yolk substitute prepared from an aqueous solution (pH, 7.0-9.5) of either soya or dairy whey.

The preferential material is a highly purified protein isolated from dairy whey **(Jewe; 1986).**

Whey powder has functional properties and applications in confectionery, bakery, meat, soup, sauce, products, lactose, dairy sweeteners **(Anon; 1988).**

Utilization of whey has been of great concern in both, large and small scale dairy industry manufacturing chhana, paneer, casein and cheese. Whey has been used for development of acceptable low cost fermented / non fermented nutritious beverages **(Bamba et al; 1972, Holsinger et al; 1974 Mann; 1986, Hoogstraten; 1987, Ready et al; 1987, Gandhi; 1989, Krishnaian et al; 1989 and 1991).**

Several workers have utilized cheese whey for alcohol producion **(Zakrzenski and Zmarlicki; 1988, Savova; 1991, Rowkas et al; 1991).**

The attempts to exploit chhana whey/ paneer whey which is better fermentation medium due to presence of more fermentable carbohydrate and less amount of ash **(Ranganathan and Kulkarni; 1980).**

Indian dairy industry is seeking new product ideas and technologies for diversification to meet the expanding consumer's requirements and increased profitability market demand for instant foods and beverages and is growing all over the world and consumers are seeking new taste. Pre-eminence of whey as an excellent beverage base has been recognized, as it is a genuine thirst quencher. Whey drinks are light, refreshing, healthful and nutritious but less

acidic than fruit juices and offers good profit margins **(Prendergast; 1985, Jelen; 1992).**

Knight et al (1972), have suggested the use of *saccharomyces fragilis yeasts* which utilizes lactose completely 20-40 % of proteins from whey in 8-12 hr. with a concurrent BOD decline by 60-80 percentage.

Keay (1971), has indicated use of whey in baked foods, dry mixes, ice-cream, icings, frostings, jams, apple butter, leelollies, butter mixes, whey soya beverages, processed cheese and whey soya blends.

In U.S.A out of 34.6 million kg dried whey 49.3 % was utilized by food industries for manufacture of baked and confectionery products, cheese foods, cake mixes, seasoning mixes and gravy mix. In addition to dried whey has also been used in fruit yoghurt, dairy spreads, cheese flovours, dips and various types of blends **(Singhleton; 1974).**

According to **(Nickerson; 1978)**, whey has been used to improve the flavour, texture, appearance and shelf life of baked foods, dry mixes ice-cream, sherbat, jams and beverages. However he has suggested conversion of lactose into glucose and galactose by acid of process to overcome crystallization of lactose in foods.

Whey and whey derived products besides being a nutritional ingredient in various foods can almost be used as functional ingredient supplying flavour, texture, colour and aeration properties in variety of foods **(Kinsella; 1995 Mon and Foegeding; 1990).**

A new fermented whey product, *EMPUR-116* developed to impart improved textural and eating qualities to a range of food systems application includes, puddings, soups, sauces, gravies and spoonable, pourable and dressings **(Food Engineering; 1989).**

2.2 Soup:-

2.2.1 Definition:-

Soup is a processed food product, especially ready to cook convenience and has an important role as a popular delicacy because of their nourishing, appetizing, easily digestible and palatable qualities.

Soups have played an important role as delicacy and have been a part of meals in parties and celebrations. Various formulated soups have gained popularity because of their nourishing and appetizing qualities and have created their position in food habit of many countries **(Ghosh; 1994).**

In recent years, processed food products especially ready to cook convenience, fast foods are gaining popularity in the global market. The consumer preference towards various processed products has led to the processing of mushrooms, chutneys, pickles, soups, flavours etc. **(Singh et al; 1995).**

2.2.2 Classification:-

1) Vegetable soup
2) Fruit soup
3) Meat soup
4) Fish soup
5) Miscellaneous soup

2.2.3 Uses:-

Whey can be successfully utilized in bakery, soup, sauce and filled dairy gel **(Mann; 1991).**

Whey and whey proteins can successfully be blended with other dairy or nondairy ingredients for use in bakery, candy, soup and sauce manufacturing **(Reeves; 1982)** .

Formulae were given by **Rippen and Mannus (1970)**, for the production of chocolate flavoured cheese, confectionery, blue cheese, smoke flavoured cheese, frozen whipped cream, dehydrated cream of tomato soup.

Hedrick-TI (1969), informed briefly on new and improved dairy products and processing methods in U.S.A., covering dairy spreads, frumil dairy deserts, cherry milk drink, frozen whipped cream, cheese, confectionery, flavoured whey beverages, dried blue-veined cheese, dried cream tomato soup, dried egg nodule, instant breakfast, milk tablet and coffee whitener.

Tomato soup concentrates have sufficient solids content to provide microbiological stability while preventing the concentrate from solidifying at home freezer temp. (Grasser et al, 1972).

Landsman (1975), analyzed the caloric value of tomato soup and found it as 57-79 kcal/100gm

Schreiber et al (1975), described the process for modifying the flavour of a tomato soup by use of 2-phenyl - 4-pentenal.

Anema et al (1981), described the process for producing aqueous concentrates, which can be pasteurized and subsequently reconstituted into lump-free thick soup, sauce, gravy, or dessert. It involves producing a concentrate including tomato soup concentrate.

A solid concentrate for making e.g. orange fruit drink or tomato soup contains a proportion of a mixture of natural fruitpectin (such as citrus pulp) and finally divided hydrophobic cellulosic fiber (such as bran). A vegetable oil may also be present **(Reigler; 1980).**

2.2.4. Production:-

According to bulletin published on **Food statistics, Ministry of Agriculture and Irrigation, Govt. of India (1977)**, the production of fruit and vegetables during 1947 was 1,65,000 tonnes, out of which 18 tonnes were used for making soups (12 tonnes in northern zone and 4.6 tonnes in southern zone).

2.3.1. Tomato:-

The tomato, botanical name *Lycopersicon esculatum, Mill* belongs to family Solanaceae. It is herbaceous annual plant with flower, which are bisexuasl, fruit is true berry. Tomato is one of the most popular and widely grown vegetable in the world. Tropical America is believed to be native place for this vegetable crop. **(Thomson and Kelly; 1957).**

Tomato is one of the most important protective food both because of its nutritive value and also due to its wide spread production. It is world's largest vegetable crop after potato and sweet-potato but it tops the list of canned vegetable. Tomato is a rich source of Vit. C. It is used as salad, soup, paste, ketchup, puree of juice, sauce, tomato soup powder, pickles **(Talbert; 1953).**

2.3.2. Nutritive Value of Tomato:-

According to the **Nedkarni (1972)**, tomato has many medicinal use the pulp and juice are digestive, mild operant, promoter of gastric secretion and blood purifier. It is also considered to be intestinal antiseptic. It is said to be healer in a cancer of mouth and sore of mouth etc. It stimulates torpid liver and is good for chronic dyspepsia. It is one of the most important vegetables, which keeps our stomach and intestines in good condition.

The composition of fruit for 100 gm. of edible portion. **(Aykroyd;1963)**. The nutritive value is written in the following table:-

Table No.6

Nutritive value of tomato fruit:-

Constituents	Amount	Constituents	Amount
Moisture	93.1mg	Thiamine	0.07mg
Protein	1.9mg	Riboflavin	0.01mg
Fat	0.1mg	Nicotine	0.4mg
Minerals	0.6gm	Vit.C.	31mg
Fibre	0.7gm	Calories	23cal.
Potassium	3.6mg	Ca	15mg
Cu	0.19mg		
Mg	2mg		
Oxalic Acid	2mg		
PO_4	36mg		
Cl_2	36mg		
Fe	18mg		
Vitamin A	320 I.U.		

2.3.3 Production and Cultivation of Tomato:-

Tomato is cultivated in India in 3.52 lakh hectare with a total production of 5.3 million tonnes. Punjab has become an important tomato growing state for processing with an average yield of 12.1 tonnes / hectare, after the entering of Pepsi foods. The productivity is 13.16 tonnes. **(Survey of Indian Agriculture; 1999).**

Vegetable plays an important role in the balanced diet of human being by providing not only the energy rich food but also vital protective nutrients like minerals, salts, vitamins. These vegetables are good source of protein too.

Kramer and Kwee (1977), studied the functional and nutritional properties of tomato protein found to be different

from the soya protein but it was similar in nutritive value to soya or cotton seed concentrate at pH 4.8-3.5.

Heinz (1970), studied the heating effect on juice. The juice was extracted and part of it was frozen, other parts heated at 9°C for 10-40 minutes and then sterilized at 110°C for 84 sec. or at 121°C for 84 sec or at 121°C for 42 and 16 sec. As heating temp. and time increased lycopene and ascorbic acid decreased and serum colour increased.

Sindhu et al (1975), studied effect of processing on tomato juice quality and ascorbic acid content was determined at different stages of processing. Ascorbic acid content for fresh juice was 20.2-20.7 mg / 100 gm for cold extraction and 23.7–24.2 mg / 100 gm for hot extraction. About 90.3 % ascorbic acid was retained after processing in cold condition whereas ascorbic acid was retained 93. 7 % in hot condition.

Chapter ---3

MATERIALS AND METHODS

MATERIALS AND METHODS

The various materials and methods were adopted for preparing "Whey Tomato Soup" and product analysis was carried out in this experiment are enlisted below.

PROCESSING OPERATIONS:

3.1 Selection and collection of ingredients.

3.2 Testing of ingredients

3.3 Determination of amount of ingredients.

3.4 Preparation of control tomato soup on the basis of standard recipe.

3.5 Preparation of paneer and collection of whey.

3.6 Preparation of whey tomato soup.

3.7 Sensory evaluation of control and experimental soups

3.7 (i) Aroma

3.7 (ii) Colour and appearance

3.7 (iii) Consistency

3.7 (iv) Taste

3.7 (v) Overall acceptance of the product.

3.8 Chemical Analysis.

3.8 (i) Total solids.

3.8 (iii) Ascorbic acid.

3.8 (iv) Protein

3.8 (v) Lactose

3.8 (vi) Calcium

3.1 SELECTION AND COLLECTION OF INGREDIENTS :-

3.1.1 Milk :--

Standardized milk collected from the "Student training Dairy" Allahabad Agricultural Institute (Deemed University), Allahabad was used for preparation of paneer and collection of whey.

3.1.2 Tomatoes:--

Fresh, good quality, edible tomatoes were procured from local market of Allahabad.

3.1.3 Corn Flour:--

Weikfield brand corn flour was used.

3.1.4 Sugar :--

Sugar was purchased from local market.

3.1.5 Butter :--

Amul brand butter was purchased.

3.1.6 Salt:--

Commercially available TATA brand salt was used.

3.1.7 Black Pepper :--

Black pepper powder was used which was purchased from Allahabad City.

3.1.8 Onion :--

Onion was purchased from local market of Anandaa City.

3.1.9 Plastic cups :--

Plastics cups were purchased from the local market.

3.1.10 Other materials :--

Other materials such as muslin cloth, strainer, pressure cooker, mixer, frying pan, measuring cylinders, beaker, knife, thermometer, kerosene stove etc. were used during the experimental study.

3.2 TESTING OF INGREDIENTS:-

Fat percentage of paneer whey was determined as per procedure given in I.S.58. Part I

pH of the paneer whey was determined with the help of digital pH meter.

3.3 DETERMINATION OF AMOUNT OF INGREDIENTS :--

Preliminary trials were conducted in the laboratory and the samples were tested organoleptically by the teaching staff drawn from the Department of Dairy Technology and Department of Chemistry.

3.3.1 Determination of thickener:-

The different types of thickeners (i.e. wheat flour, corn flour and maida) were tested on trial basis with the soup and at last it was found that corn flour was most acceptable thickener for base material.

3.4 PREPARATION OF CONTROL TOMATO SOUP:--

This standard recipe was taken from Tarla Dalal's Cookery Book and was further modified.

Table No.7: Standard recipe for Tomato soup, Control (To)

Butter	:	30gm
Onion	:	5gm
Sugar	:	30gm
Corn flour	:	33 gm
Black Pepper	:	2 gm
Salt	:	5 gm
Tomato juice	:	500 gm
Milk	:	500 ml

3.4.1. Procedure for tomato soup preparation :--

The preparation of tomato soup is given as follows:

Saute the firmly well chopped onion into butter over a slow flame in a frying pan

↓

Fry it till brown in colour and stir continuously.

↓

Add sugar, cook continuously by regular stirring.

↓

Add corn flour mixed in water and stir continuously.

↓

Cook till the whole base ingredient become gelatinized starch.

↓

Pour slowly the tomato juice and mixed well by continuous stirring over slow and gentle flame.

↓

Add salt and pepper for seasoning.

↓

Mix the milk slowly with gentle stirring.

↓

Cooking was done at a temperature 80-85°C for minutes,

↓

Switch off the flame.

↓

Collect the soup.

↓

Serve the soup into cups in hot serving condition.

3.5. PREPARATION OF PANEER AND COLLECTION OF WHEY :--

3.5.1 Flow diagram of paneer preparation and whey collection :--

Reception of milk (standardized milk 4.5 % fat)

↓

Boiling (87°C for 5 minutes).

↓

Addition of Citric acid (2 % solution at 72°C)

↓

Coagulation

↓

Filtration

↓

Pressing (2kg/cm²)

↓

Collection of whey

3.5.2. Estimation and yield of whey :--

The whey thus prepared was measured in a measuring cylinder, the percentage yield of whey was calculated by the formula.

$Y = a/b \times 100$

Where, y = Yield of whey

Where, a = Quantity of milk for preparation of paneer in ml.

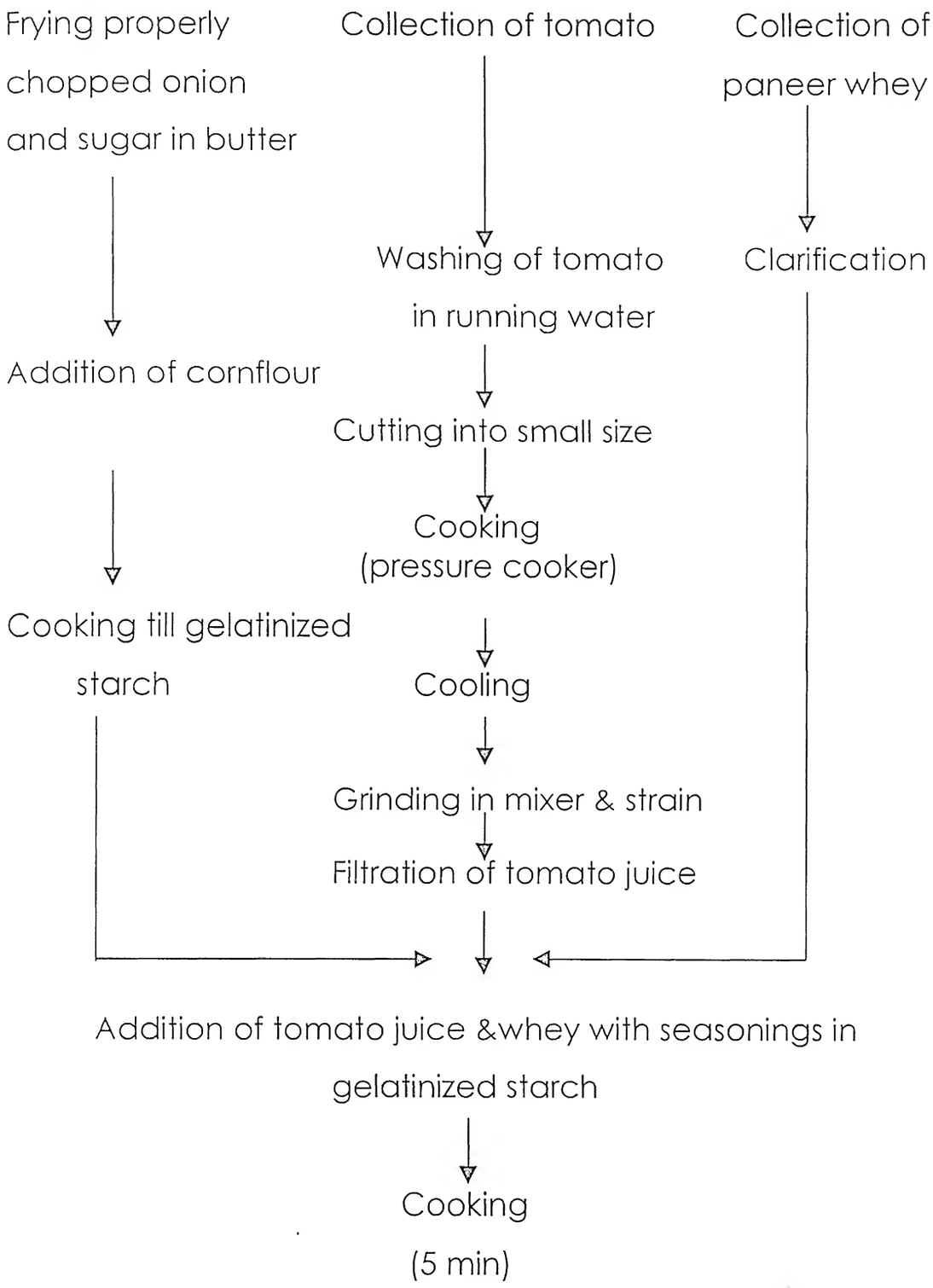
Where, b = Quantity of whey obtained after paneer preparation.

3.6 PREPARATION OF WHEY TOMATO SOUP:-

Sauté the firmly well-chopped onion into butter over a slow flame in a frying pan, fry it till brown in colour and stir continuously. Add sugar, cook continuously by regular stirring. Add corn flour mixed in water and stir continuously, cook till the whole base ingredient become gelatinized starch.

Tomatoes were cleaned and washed thoroughly in water, cut into small pieces and cooked in pressure cooker (100°C for 5 min), the tomatoes were mixed in a mixer and then strained over a strainer, pour slowly the tomato juice and mixed well by continuous stirring over slow and gentle flame. Add salt and pepper for seasoning. Mix the whey slowly with gentle stirring. Cooking was done at a temperature 80-85°C for minutes. Switch off the flame, collect the soup, serve the soup into cups in hot serving condition.

3.6.1Flow chart of whey tomato soup preparation:--



3.7 SENSORY EVALUATION:-

The sensory evaluation of control and experimental soups were done by a panel of 10 judges using a 9 point hedonic scale.

The Judges were from Department of Dairy technology and Department of Chemistry. The Data were subjected to analysis of variance to compare rating (**Senedecors/Cochran; 1967**). The samples were placed before the judges with sample code guide by random table to avoid positional bias. The panel judges graded the coded sample of soup. The format for evaluation is modeled below.

3.7.1 Score card:--

Replication No. Date :.....

Please place score card opposite the rating for perfect score and defects observed in the product may be expressed critically in the column of remarks.

Guidelines :--

1. First examine the aroma of the given samples
2. Examine the colour and appearance of the samples
3. Examine taste of the samples.
4. Examine the consistency of the samples.
5. Overall acceptability of the samples.

Characteristics	Score
like extremely	9
like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike	1

Attributes	T_0	T_1	T_2
Aroma			
Colour and appearance			
Consistency			
Taste			
Overall acceptability			

Suggestions if any

1. Aroma
2. Colour and appearance
3. Consistency
4. Taste
5. Overall acceptability

Signature

3.8 CHEMICAL ANALYSIS :--

The control and experimental soups were analyzed for the parameter mentioned below.

3.8.1. Total solids:--

The total solids in control and experimental soups were determined as per procedure in practical manual (exercise book) of biochemistry

3.8.2. Ascorbic Acid :--

The Vit. C was estimated by a procedure mentioned in the book entitled "Practical Manual for Agricultural Chemistry" by **Varshney and Gupta (1987)**

3.8.3. Protein :--

The protein content was estimated by Pyne's method.

3.8.4. Lactose:--

The lactose content was estimated by Lane and Eynon Volumetric method

3.8.5. Calcium:--

The calcium content was estimated by Wet Digestion method.

Chapter --- 4

EXPERIMENTAL FINDINGS

EXPERIMENTAL FINDINGS

Control and experimental soups were analyzed for their aroma, colour and appearance, consistency, taste, overall acceptability, total solids, ascorbic acid, protein, lactose, calcium and the economics of their preparation was studied.

The data obtained after analysis have been presented from Table No. 9 to 22 and figures I- X. These data were further analyzed statistically using the method of analysis of variance technique. The results obtained are presented in table from 12 (a) to 22 (c).

The soup prepared with standard recipe served as control (T_0), tomato soup prepared with whey served as treatment (T_1), commercial tomato soup served as treatment (T_2).

Control (T_0)	-	500 ml milk
Treatment(T_1)	-	500 ml whey
Treatment (T_2)	-	Commercial soup.

4.1 Average yield of paneer whey :

Table No. – 9

Average yield of paneer whey

Replication	Volume of milk (ml)	Volume of whey obtained (ml)	Percentage yield of whey
R_1	2000	1550	77.5
R_2	2000	1540	77.0
R_3	2000	1560	78.0
R_4	2000	1535	76.75
R_5	2000	1540	77.0
R_6	2000	1530	76.5
R_7	2000	1535	76.75
R_8	2000	1530	76.5
R_9	2000	1540	77.0
R_{10}	2000	1555	77.75
Average	**2000**	**1541.5**	**77.07**

As evident from the Table No. 9 the average yield of paneer whey was 77.07 percent

4.2 Fat % and pH of paneer whey:--

Table No. – 10

Fat percentage and pH of Paneer whey

Replication	Fat	pH
R_1	0.5	5.42
R_2	0.6	5.64
R_3	0.6	5.6
R_4	0.5	5.52
R_5	0.5	5.6
R_6	0.4	5.52
R_7	0.6	5.42
R_8	0.5	5.4
R_9	0.5	5.56
R_{10}	0.6	5.6
Average	**0.53**	**5.52**

As evident from the above table the average fat % and pH of paneer whey were 0.53 % and 5.52 respectively.

4.2 (a) pH and Ascorbic acid content of tomato juice extract :

Table No. - 11

pH and Ascorbic acid content of tomato juice extract :

Replication	pH	Vit. C (mg / 100 gm)
R_1	4.2	28.0
R_2	4.3	26.4
R_3	4.2	24.2
R_4	4.4	24.2
R_5	4.4	26.4
R_6	4.6	26.2
R_7	4.5	22.2
R_8	4.3	24.2
R_9	4.2	24.2
R_{10}	4.2	24.2
Mean	**4.33**	**25.02**
Range	**4.2-4.6**	**24.2-28.0**

As evident from the above table the average pH and Ascorbic acid content (Vit. C) mg/ 100 gm of tomato juice were 4.33 and 25.02 respectively.

4.3 Aroma:--

Table No. – 12(a)

Average score of aroma of control and experimental soups.

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	6.5	7.4	7.2
R_2	6.6	7.1	6.5
R_3	6.8	7.8	7.4
R_4	7.0	7.8	7.5
R_5	6.9	8.0	8.0
R_6	7.2	7.9	7.8
R_7	7.0	8.6	7.5
R_8	6.3	8.1	8.6
R_9	7.3	8.2	8.0
R_{10}	7.4	8.6	8.3
Mean	**6.9**	**7.95**	**7.68**
Range	**6.3-7.4**	**7.1-8.6**	**6.5-8.6**

The data given in Table No. 12 (a) shows that the average aroma score was the highest in T_1 with an average of 7.95 followed by T_2 with an average of 7.68. The lowest average score in aroma was scored by T_0 of 6.9 points.

The above result shown in Table No. 12 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 12 (b)

Table No. -12 (b)

ANOVA: Analysis of variance of average score of aroma of control and experimental soups.

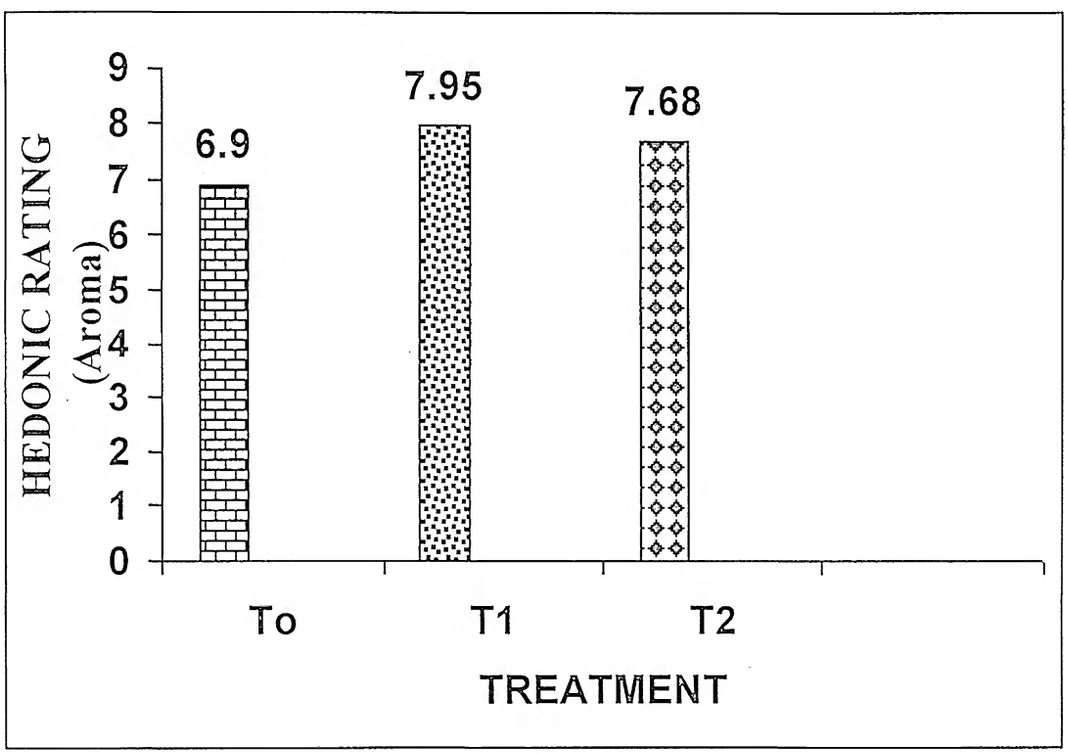
Source of variation	d.f.	S.S.	M.S.S.	F.Cal.	F. (5%)
Due to treatment	2	4.234	2.117	17.94*	3.55
Due to replication	9	5.946	0.66		
Due to error	18	2.127	0.118		
Total	29				

*** Significant**

The result presented in the ANOVA Table 12 (b) shows that the calculated value of 'F' 17.94 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 12 (b) that there was significant difference between the treatments.

Figure No. 1

Showing the average score of aroma of control and experimental soups



4.4 Colour and Appearance :--

Table No. -13 (a)

Average score of colour and appearance of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	5.7	7.2	7.6
R_2	6.0	6.9	7.4
R_3	5.9	7.2	7.8
R_4	6.3	7.4	7.7
R_5	6.7	7.7	7.7
R_6	6.6	7.9	8.2
R_7	6.5	7.9	8.2
R_8	6.6	8.1	7.7
R_9	7.0	8.2	8.5
R_{10}	6.9	8.3	8.6
Mean	**6.42**	**7.68**	**7.94**
Range	**5.7-7.0**	**6.9-8.3**	**7.4-8.6**

The data given in Table No. 13 (a) shows that the average colour and appearance score was highest in T_2 with an average of 7.94 followed by T_1 with an average score of 7.68. The lowest average score in aroma was scored by T_0 of 6.42 points.

The above result shown in Table No. 13 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 13 (b)

Table No. 13 -(b)

ANOVA: Analysis of variance of average score of colour and appearance of control and experimental soups.

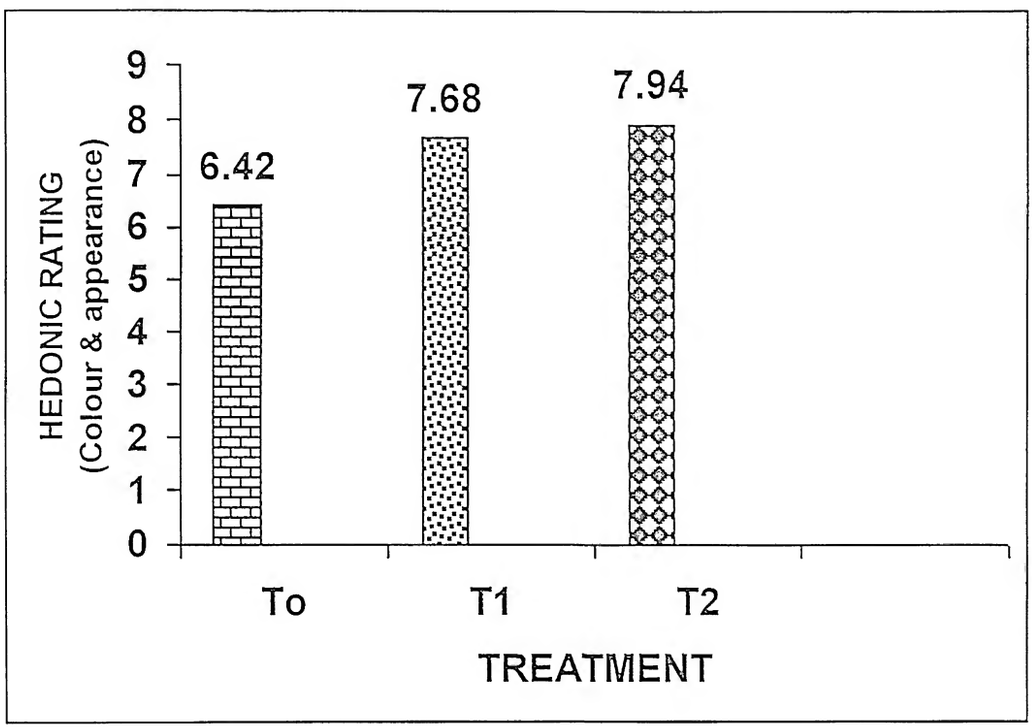
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F. (5%)
Due to treatment	2	4.615	2.308	3.905*	3.55
Due to replication	9	13.219	1.469		
Due to error	18	10.641	0.591		
Total	29				

*** Significant**

The result presented in the ANOVA Table 13 (b) shows that the calculated value of 'F' 3.905 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 13 (b) that there was significant difference between the treatments.

Figure No. 11

Showing the average score of colour and appearance of control and experimental soups



4.5 Consistency :--

Table No. -14 (a)

Average score of consistency of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	6.9	7.7	7.4
R_2	6.3	7.0	6.5
R_3	7.0	7.5	7.5
R_4	6.6	8.2	7.4
R_5	7.6	7.7	7.4
R_6	7.1	8.1	7.6
R_7	6.2	8.1	7.6
R_8	6.6	8.6	8.0
R_9	7.9	7.9	8.0
R_{10}	6.9	7.9	8.3
Mean	**6.91**	**7.08**	**7.57**
Range	**6.2-7.9**	**7.0-8.6**	**7.4-8.3**

The data given in Table No.14 (a) shows that the average consistency score was highest in T_2 with an average of 7.57 followed by T_1 with an average score of 7.08. The lowest average score in consistency was scored by T_0 of 6.91 points.

The above result shown in Table No. 14 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 14 (b)

Table No. -14 (b)

ANOVA: Analysis of variance of average score of Consistency of control and experimental soups.

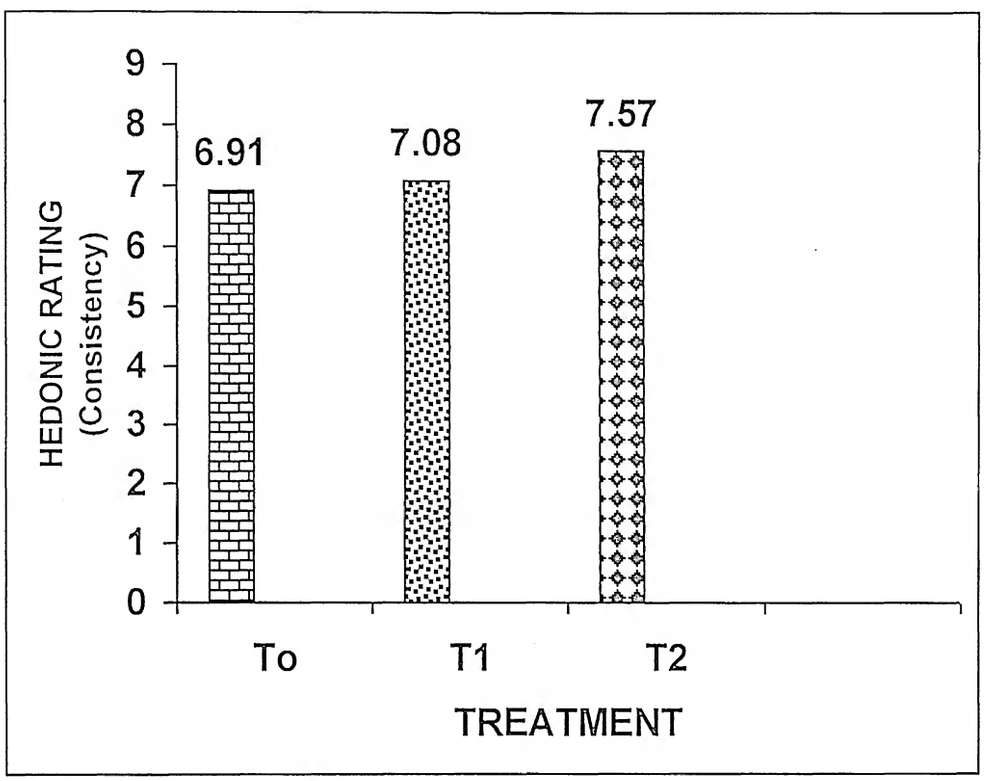
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F. (5%)
Due to treatment	2	3.562	1.781	11.272*	3.55
Due to replication	9	4.824	0.536		
Due to error	18	2.849	0.158		
Total	29				

*** Significant**

The result presented in the ANOVA Table 14 (b) shows that the calculated value of 'F' 11.272 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 14 (b) that there was significant difference between the treatments.

Figure No. 111

Showing the average score of consistency of control and experimental soups



4.6 Taste:--

Table No. -15 (a)

Average score of taste of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	6.3	7.4	7.7
R_2	6.5	8.2	6.9
R_3	6.0	8.0	7.2
R_4	6.9	8.2	7.5
R_5	6.8	8.2	7.7
R_6	7.2	8.6	7.9
R_7	7.1	8.6	7.9
R_8	6.3	8.9	8.2
R_9	6.3	8.5	8.1
R_{10}	7.0	7.7	8.2
Mean	**6.62**	**8.22**	**7.33**
Range	**6.0-7.2**	**7.4-8.9**	**6.9-8.2**

The data given in Table No. 15 (a) shows that the average taste score was highest in T_1 with an average of 8.22 followed by T_2 with an average score of 7.33. The lowest average score in taste was scored by T_0 of 6.62 points.

The above result shown in Table No. 15 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 15 (b)

Table No. - 15 (b)

ANOVA: Analysis of variance of average score of taste of control and experimental soups.

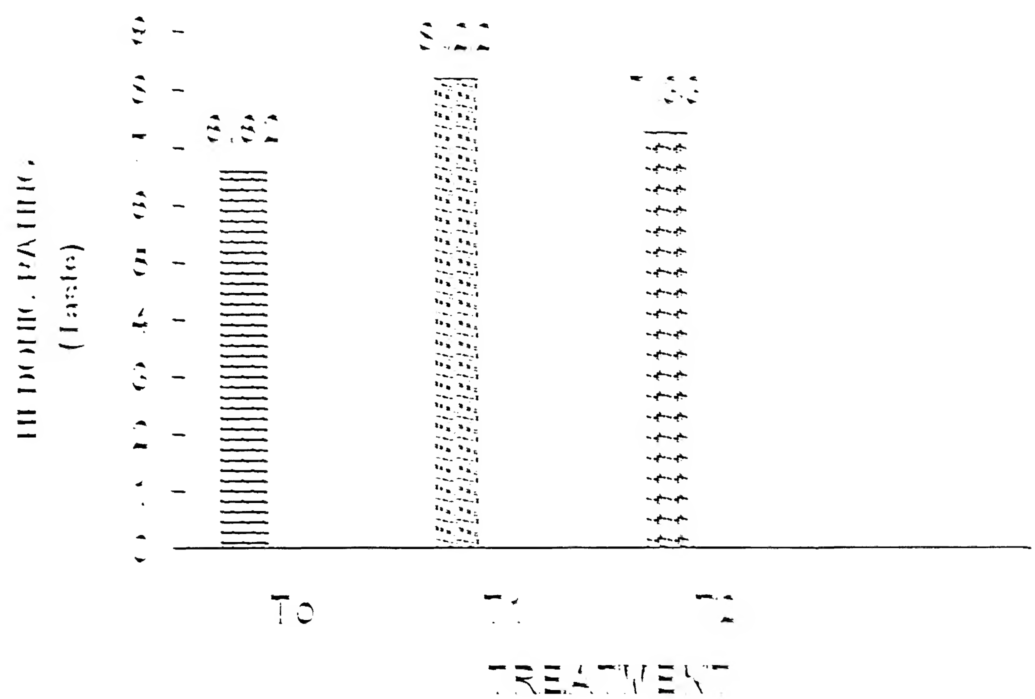
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F. (5%)
Due to treatment	2	2.48	1.24	8.857*	3.55
Due to replication	9	13.221	1.469		
Due to error	18	2.526	0.14		
Total	29				

*** Significant**

The result presented in the ANOVA Table 15 (b) shows that the calculated value of 'F' 8.857 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 15 (b) that there was significant difference between the treatments.

Figure No. [illegible]

Showing the average score of taste of control and experimental soups



4.7 Overall acceptability :--

Table No. - 16 (a)

Average score of overall acceptability of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	6.275	7.55	7.825
R_2	6.225	6.35	6.5
R_3	7.55	7.95	8.1
R_4	6.9	8.2	8.2
R_5	6.12	8.7	7.925
R_6	7.25	7.9	7.9
R_7	6.825	8.125	7.8
R_8	7.025	8.375	8.075
R_9	7.225	8.0	8.8
R_{10}	6.375	8.4	8.225
Mean	**6.7545**	**7.985**	**7.935**
Range	**6.12-7.55**	**6.35-8.7**	**6.5-8.8**

The data given in Table No. 16 (a) shows that the average overall acceptability score was highest in T_1 with an average of 7.985 followed by T_2 with an average score of 7.935. The lowest average score in overall acceptability was scored by T_0 of 6.7545 points.

The above result shown in Table No.16 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 16 (b)

Table No. 16 - (b)

ANOVA: Analysis of variance of average score of overall acceptability of control and experimental soups.

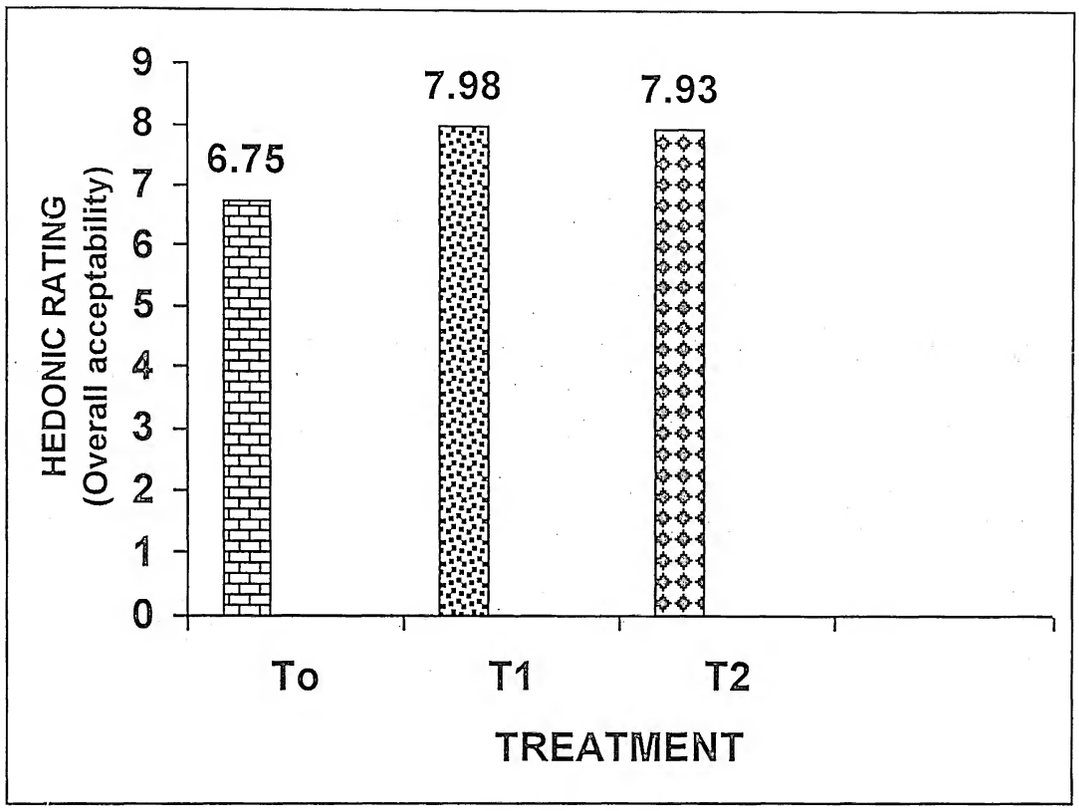
Source of variation	d.f.	S.S.	M.S.S.	F. Cal	F. (5%)
Due to treatment	2	5.994	2.997	17.424*	3.55
Due to replication	9	9.057	1.006		
Due to error	18	3.096	0.172		
Total	29				

*** Significant**

The result presented in the ANOVA Table 16 (b) shows that the calculated value of 'F' 17.424 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 16 (b) that there was significant difference between the treatments.

Figure No. V

Showing the average score of overall acceptability of control and experimental soups



4.8 Total solids :--

Table No. -17 (a)

Average of total solids % of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	16.0	12.0	11.0
R_2	16.5	12.0	11.5
R_3	16.5	12.5	11.5
R_4	16.0	12.4	11.5
R_5	17.0	12.5	11.5
R_6	17.0	12.0	11.5
R_7	16.5	12.0	11.0
R_8	17.0	12.5	11.5
R_9	17.0	12.5	11.5
R_{10}	16.5	12.0	11.0
Mean	**16.65**	**12.25**	**11.35**
Range	**16.0-17.0**	**12.0-12.5**	**11.0-11.5**

The data given in Table No. 17 (a) shows that the average total solids % score was highest in T_0 with an average of 16.65 followed by T_1 with an average score of 12.25. The lowest average score in total solids % was scored by T_2 of 11.35 points.

The above result shown in Table No. 17 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 17 (b)

Table No. 17 (b)

ANOVA: Analysis of variance of average of total solids % of control and experimental soups.

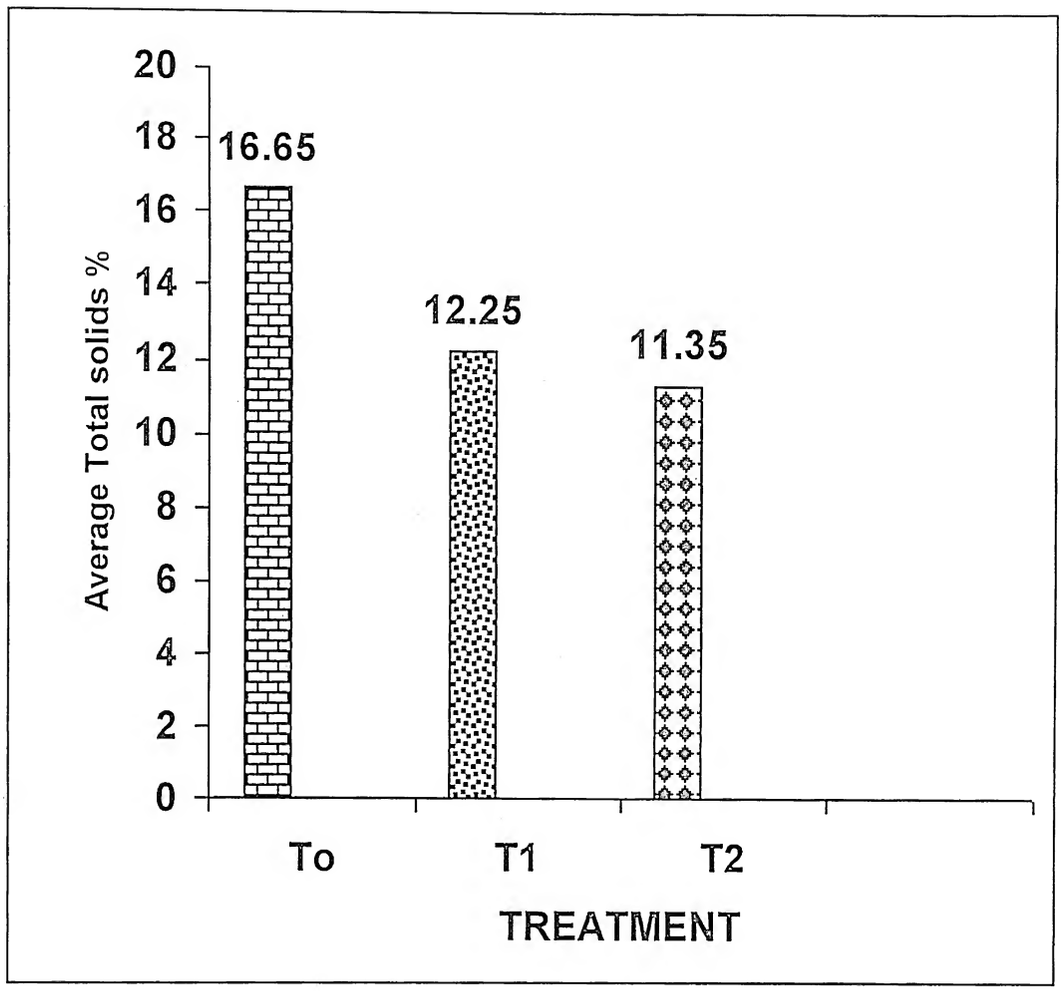
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F. (5%)
Due to treatment	2	1.55	0.775	14.623*	3.55
Due to replication	9	157.881	17.542		
Due to error	18	0.959	0.053		
Total	29				

*** Significant**

The result presented in the ANOVA Table 17 (b) shows that the calculated value of 'F' 14.623 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 17 (b) that there was significant difference between the treatments.

Figure No. V1

Showing the average total solids % of control and experimental soups



4.9 Ascorbic Acid :--

Table No. -18 (a)

Average of ascorbic acid (Vit. C) content (mg. / 100gm) of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	9.4	9.1	9.0
R_2	10.3	10.1	9.1
R_3	11.3	9.0	9.0
R_4	11.2	10.2	8.9
R_5	10.3	11.2	8.7
R_6	12.4	9.0	8.6
R_7	9.3	9.3	8.5
R_8	9.4	9.5	9.0
R_9	13.5	9.5	8.9
R_{10}	9.1	9.0	8.8
Mean	**10.62**	**9.59**	**8.87**
Range	**9.1-13.5**	**9.0-11.2**	**8.5-9.1**

The data given in Table No. 18 (a) shows that the average ascorbic acid content score was highest in T_0 with an average of 10.62 followed by T_1 with an average score of 9.59. The lowest average score in ascorbic acid content was scored by T_2 of 8.87 points.

The above result shown in Table No. 18 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 18 (b)

Table No. -18 (b)

ANOVA: Analysis of variance of average of ascorbic acid (Vit. C) content (mg/100 gm) of control and experimental soups.

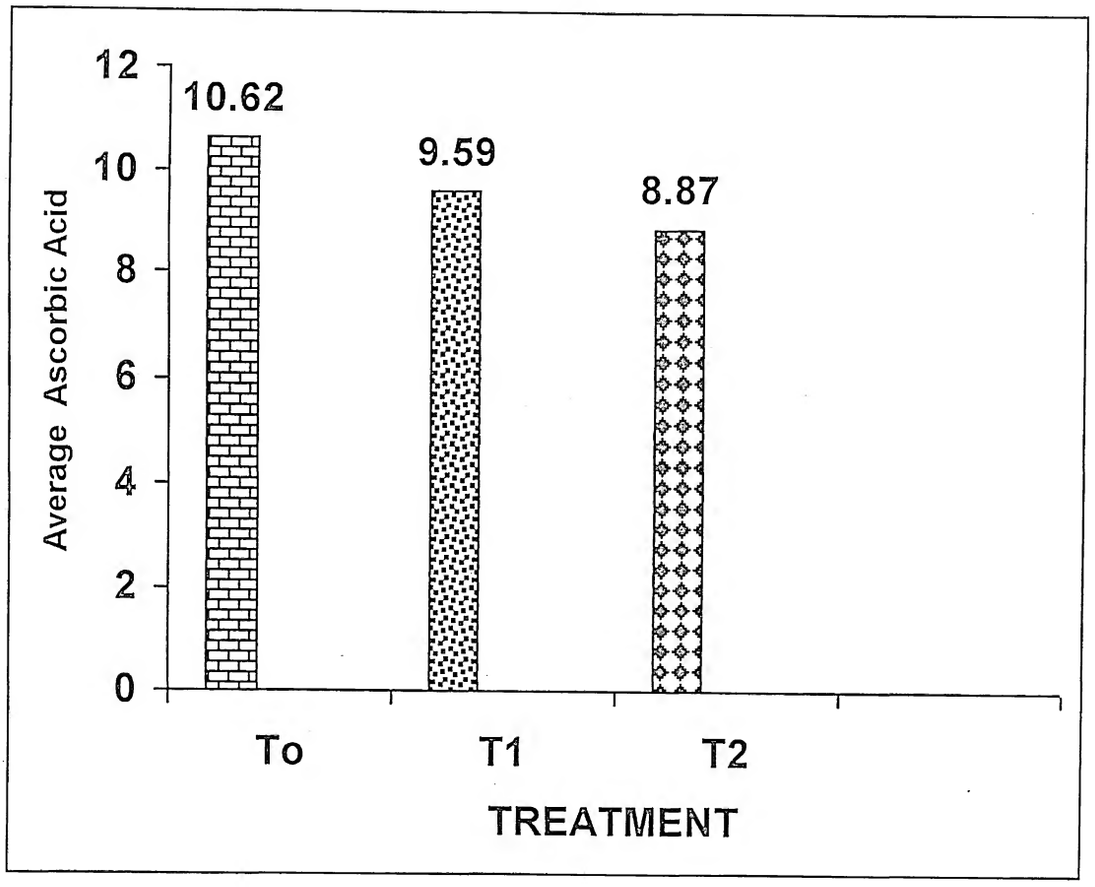
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F (5%)
Due to treatment	2	8.108	4.054	4.465*	3.55
Due to replication	9	15.805	1.756		
Due to error	18	16.342	0.908		
Total	29				

*** Significant**

The result presented in the ANOVA Table 18 (b) shows that the calculated value of 'F' 4.456 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 18 (b) that there was significant difference between the treatments.

Figure No. V11

Showing the average of ascorbic acid (Vit.C) content of control and experimental soups



4.10 Protein :--

Table No. - 19 (a)

Average % of protein content of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	3.2	0.9	1.12
R_2	3.4	1.1	1.12
R_3	3.3	0.9	1.12
R_4	3.4	1.1	1.12
R_5	3.3	1.2	1.12
R_6	3.3	1.2	1.12
R_7	3.4	0.9	1.12
R_8	3.4	0.9	1.12
R_9	3.5	0.9	1.12
R_{10}	3.2	1.0	1.12
Mean	**3.34**	**1.01**	**1.12**
Range	**3.2-3.5**	**0.9-1.2**	**---**

The data given in Table No. 19 (a) shows that the average protein % score was highest in T_0 with an average of 3.34 followed by T_2 with an average score of 1.12. The lowest average score in protein % was scored by T_1 of 1.01 points.

The above result shown in Table No.19 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 19 (b)

Table No.- 19 (b)

ANOVA: Analysis of variance of average % of protein content of control and experimental soups.

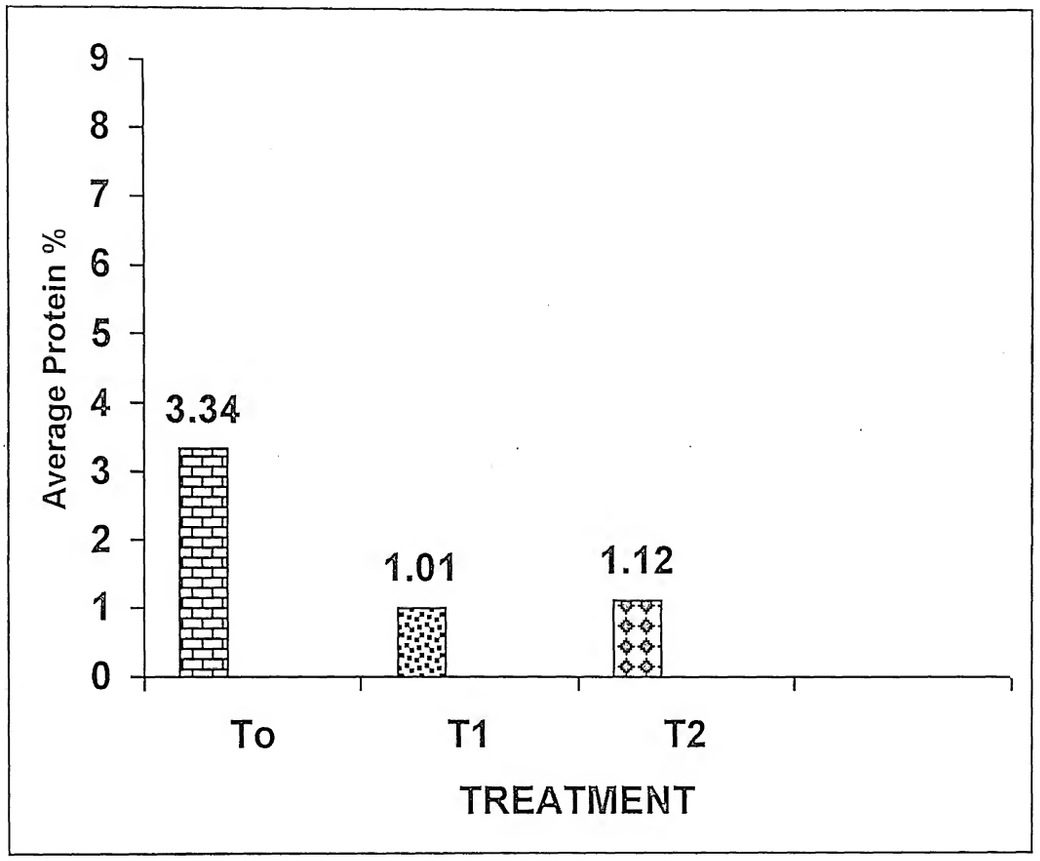
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F. (5%)
Due to treatment	2	0.067	0.034	3.778*	3.55
Due to replication	9	34.565	3.84		
Due to error	18	0.166	0.009		
Total	29				

*** Significant**

The result presented in the ANOVA Table 19 (b) shows that the calculated value of 'F' 3.778 for treatments was greater than the table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 19 (b) that there was significant difference between the treatments.

Figure No. V111

Showing the average % of protein content of control and experimental soups



4.11 Lactose :--

Table No. - 20 (a)

Average % of lactose content of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	3.9	4.05	7.3
R_2	3.9	4.05	7.3
R_3	3.6	4.0	7.3
R_4	3.6	4.0	7.3
R_5	3.8	4.02	7.3
R_6	3.8	4.02	7.3
R_7	3.9	4.05	7.3
R_8	3.9	4.05	7.3
R_9	3.6	4.0	7.3
R_{10}	3.9	4.05	7.3
Mean	**3.79**	**4.02**	**7.3**
Range	**3.6-3.9**	**4.0-4.05**	**---**

The data given in Table No. 20 (a) shows that the average lactose % score was highest in T_2 with an average of 7.3 followed by T_1 with an average score of 4.02. The lowest average score in lactose % was scored by T_0 of 3.79 points.

The above result shown in Table No. 20 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 20 (b)

Table No. - 20 (b)

ANOVA: Analysis of variance of average %of lactose content of control and experimental soups.

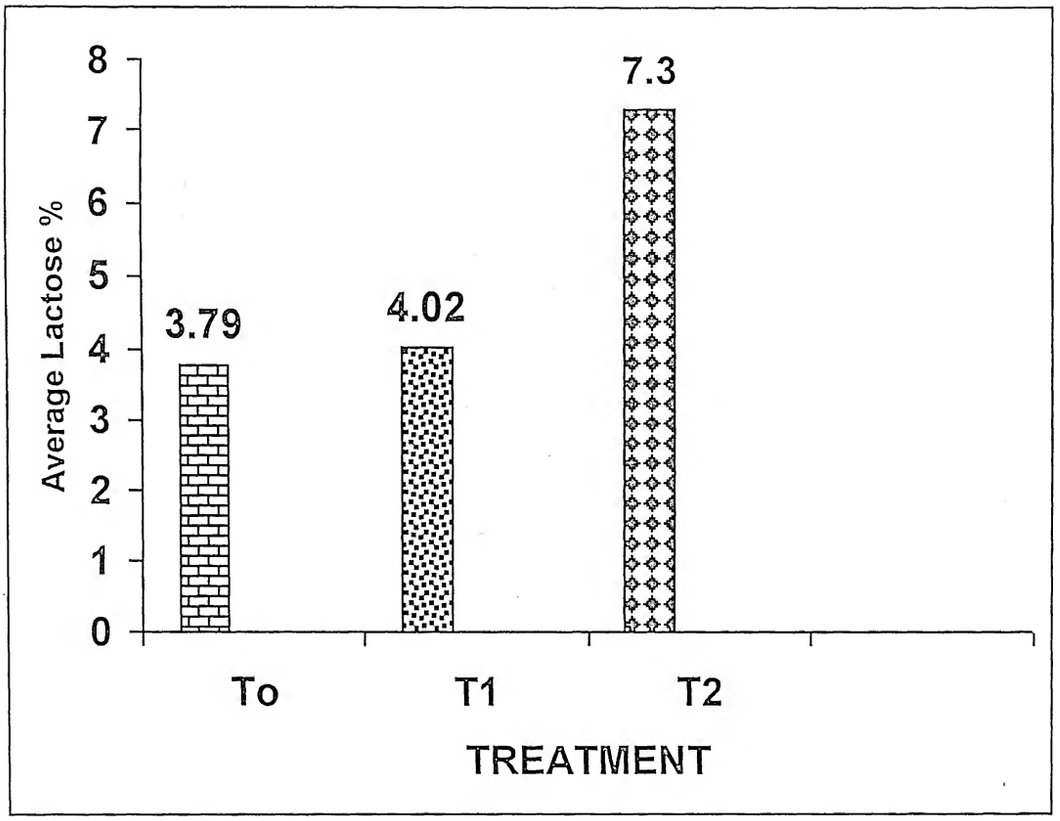
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F .(5%)
Due to treatment	2	0.077	0.039	7.8*	3.55
Due to replication	9	76.922	8.547		
Due to error	18	0.084	0.005		
Total	29				

*** Significant**

The result presented in the ANOVA Table 20 (b) shows that the calculated value of 'F' 7.8 for treatments was greater than table value of 'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 20 (b) that there was significant difference between the treatments.

Figure No. 1X

Showing the average % of lactose content of control and experimental soups



4.12 Calcium:--

Table No. - 21 (a)

Average of calcium content (mg / 100 gm) of control and experimental soups

Replication	Control T_0	Treatment T_1	Treatment T_2
R_1	165	80	124
R_2	165	80	124
R_3	165	80	124
R_4	163	78	124
R_5	162	79	124
R_6	162	79	124
R_7	162	79	124
R_8	163	78	124
R_9	165	80	124
R_{10}	165	80	124
Mean	**163.7**	**79.3**	**124**
Range	**162-165**	**78-80**	**---**

The data given in table No. 21 (a) shows that the average calcium content score was highest in T_0 with an average of 163.7 followed by T_2 with an average score of 124. The lowest average score in calcium content was scored by T_1 of 79.3 points.

The above result shown in Table No. 21 (a) was further statistically analyzed using the method of analysis of variance technique. Thus the result obtained are presented in Table No. 21 (b)

Table No.- 21 (b)

ANOVA: Analysis of variance of calcium content (mg / 100 gm) of control and experimental soups.

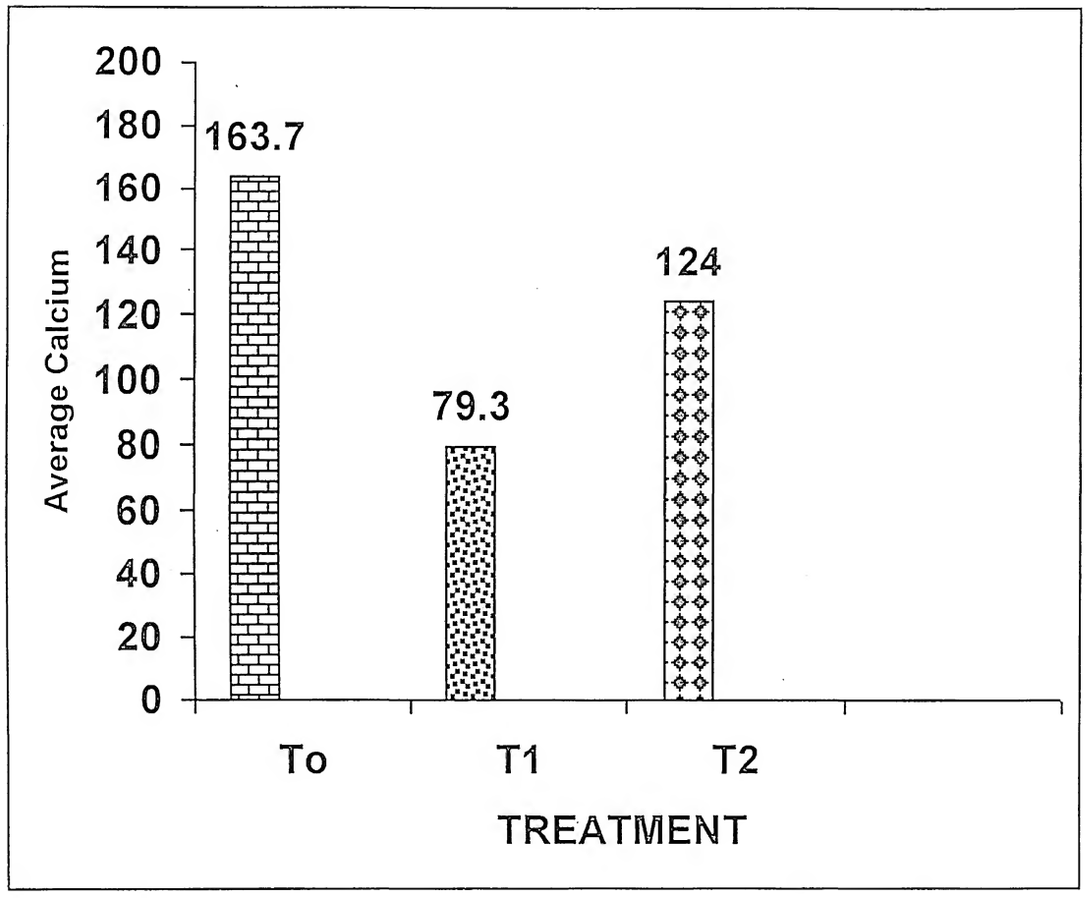
Source of variation	d.f.	S.S.	M.S.S.	F.Cal	F. (5%)
Due to treatment	2	13.334	6.667	11.038*	3.55
Due to replication	9	35658.47	3962.05		
Due to error	18	10.866	0.604		
Total	29				

*** Significant**

The result presented in the ANOVA Table 21 (b) shows that the calculated value of 'F' 11.038 for treatments was greater than table value of'F' 3.55 at 5 % level of significance. Therefore it is evident from the Table No. 21 (b) that there was significant difference between the treatments.

Figure No. X

Showing the average of calcium content of control and experimental soups



4.13 Cost Analysis:--

The cost ingredient is very important factor besides other factor in determining the cost of production. It is basis for price fixation and determining the profit. A product is dependent on the cost of production.

Table No. – 22 (a)

Ingredients and cost of commercial soup

Ingredients	Sugar, tomato, wheat flour, edible starch, milk solids, salt onion powder, monosodium glutamate, beetroot juice powder, citric acid, spices and garlic powder
Dry weight	70 gms.
Quantity	600 ml. (after dissolving in water)
cost	Rs. 25.00

Table No. - 22 (b)

Average cost of production of control soup.

Ingredients	Amount of ingredients required for making 1000 ml. soup	Rate (Rs.)	Cost (Rs.)
Butter	30 gm	Rs. 12/100gm	3.6
Sugar	30 gm	Rs. 16/ kg	0.48
Cornflour	33gm	Rs. 8.50/200 gm	1.4
Black pepper	2gm	Rs. 10/50 gm	0.4
Salt	5 gm	Rs. 6/ kg	0.03
Onion	5 gm	Rs. 6/kg	0.03
Tomato	500 gm	Rs. 5/ kg	2.5
Milk	500 ml	Rs. 14/kg	7.0
Cooking fuel (K-oil)	200 ml	Rs. 8/ litre	1.6
		Total cost (Rs.)	**17.04**

Table No.- 22 (c)

Average cost of production of whey soup.

Ingredients	Amount of ingredients required for making 1000 ml. soup	Rate (Rs.)	Cost (Rs.)
Butter	30 gm	Rs. 12/100gm	3.6
Sugar	30 gm	Rs. 16/ kg	0.48
Cornflour	33gm	Rs. 8.50/200 gm	1.4
Black pepper	2gm	Rs. 10/50 gm	0.4
Salt	5 gm	Rs. 6/ kg	0.03
Onion	5 gm	Rs. 6/kg	0.03
Tomato	500 gm	Rs. 5/ kg	2.5
Whey	500 ml	0	0
Cooking Fuel (K-oil)	200 ml	Rs. 8/ litre	1.6
		Total cost (Rs.)	**10.04**

The average cost of production of 1000 ml of control soup was Rs. 17.04 in Table 22 (b) whereas the whey soup cost Rs. 10.04 in Table 24 (b). Above all the cost of 500 ml pack of commercial soup is Rs. 25.00.

The cost of production of whey soup is almost half of the price of control soup and one fourth of the price of commercial soup. The cost of paneer whey is not added in the cost of production of whey soup because paneer whey is waste by-product, which is usually dumped into sewages.

Chapter ---5

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The present study was conducted primarily to optimize a technique for processing of tomato soup from paneer whey. The data collected on different aspects as per plan was tabulated and statistically analyzed. The result from the analysis during the course of investigation were presented in previous chapter.

In this chapter results are discussed in detail in the following sequence.

Effect of the treatments on aroma attributes of the product:--

The data area regarding the aroma of the product samples rated by a panel of judges as influenced by various treatments are represented in table No. 12 (a) and fig I. The ANOVA of the same is given in table 12(b). The table no. 12 (a) reveals that the highest average aroma score was observed in case of treatment T_1 (7.95) and it ranged (7.1-8.6) followed by T_2 with as average aroma score (7.68) and it ranged from (6.5-8.6) and lastly by T_0 with an average aroma score (6.9)and it ranged from (6.3-7.4).

The calculated 'F' value of treatments was found to be 17.94 greater than the table value of 'F' 3.55 at 5 % probability level. Since the calculated 'F' value was greater than the table value therefore it is concluded that there was significant difference between treatments.

It is noted from the above result that marked increase in aroma score was observed in T_1 sample containing 500 ml of whey. Thus the result reveals that the sample T_1 containing 500 ml of whey score higher than the commercial sample T_2 and control sample T_0 and has found to be best suited for aroma of the product.

Effect of the treatments on colour and appearance attributes of the product:--

The data regarding the colour and appearance attributes of the product samples rated by panel of judges as influenced by various treatments are furnished in table no. 13 (a) and Fig 2. The ANOVA of the same is given in table 13 (b).

From the table no. 13 (a) it is evident that the highest average colour and appearance score was observed in T_2 (7.94) and it ranged (7.4-8.6) followed by T_1 (7.68) and it ranged from (6.9-8.3) and lastly by T_o with an average colour and appearance score (6.42) and it ranged from (5.7-7.0).

The average colour and appearance score of the product was statistically analyzed using the method of analysis of variance technique. The calculated 'F' value of treatments was found to be 3.905 while the table 'F' value for respective degree of freedom at 5 % probability level was 3.55. Since the calculated value exceeds the table value therefore it is concluded that there was significant difference between the treatments. It is noted from the above results

that slight increase in colour and appearance score was observed in T_2 sample i.e. commercial tomato soup followed by T_1 sample i.e. whey soup.

Thus the results reveal that sample T_2 scored higher than the control T_0 and whey soup T_1 and is found to be best suited for colour and appearance of the product.

Effect of the treatments on the consistency attributes of the product:--

The data regarding the consistency attributes of the product samples rated by a panel of judges and influenced by various treatments are represented in table no. 14 (a) and fig 3.

The ANOVA of the same is given in table no. 14 (b). The table no. 14 (a) reveals that the highest average consistency score was observed in T_2 (7.57) it ranged from (7.4- 8.3) followed by T_1 with an average consistency score (7.08) and it ranged from (7.0-8.6) and lastly T_0 with average consistency score of (6.91) and it ranged from (6.2-7.9).

The average consistency score of the product sample were statistically analyzed using the method of analysis of variance technique. The calculated 'F' value of treatment was found to be 11.272. The table value of 'F' at 5 % probability level was 3.55. Since the calculated 'F' value was higher than the table value therefore it is concluded that there was a significant difference between the treatments.

It is noted from the above result that slight increase was observed in consistency score of T_2 sample i.e. commercial

tomato soup. The result reveals that the sample T_2 has higher consistency score than the control T_0 and whey soup T_1 and is found to be suited for consistency of the product.

Effect of the treatments on taste attributes of the product:-

The data regarding the product samples rated by a panel of judges as influenced by various treatments are furnished in table no. 15 (a) and fig. 4. The ANOVA of the same is given in table no. 15 (b)

From the table no. 15 (a) it is evident that highest score was observed in T_1 sample ranged from (7.4-8.9) with an average score of (8.22) followed by the taste score of T_2 ranged from (6.9-8.2) and average score of (7.33) and lastly the control sample T_0 taste score ranged from (6.0-7.2) and average taste score of (6.62).

The data regarding taste rating of the product samples were statistically analyzed by using method of analysis of variance technique. The results are presented in table no. 15 (b). The calculated 'F' value of treatment was found to be 8.857, whereas table value of 'F' at 5 % probability level was 3.55. The calculated 'F' value was greater than table value therefore it is concluded that there was significant difference between the treatments.

It is noted from the above result that marked increase was observed in taste score of T_1 sample containing 500 ml of whey. The result reveals that T_1 sample containing 500 ml whey has higher taste score than the control sample T_0 and

commercial soup T_2. Thus the result suggests that T_1 sample is best suited for taste of the product.

Effect of the treatments on overall acceptability attributes of the product:-

The data regarding the overall acceptability of the product samples rated by panel of judges as influenced by various treatments are already presented in table no. 16 (a) and fig 5. The ANOVA of the same is given in table no. 16 (b).

The table no. 16 (a) reveals that the highest average overall acceptability score was observed in case of T_1 (7.985) and it ranged from (6.35-8.7) followed by T_2 with an average score of (7.935) and it ranged from (6.5-8.8) and lastly the average overall acceptability score of control sample T_0 (6.7545) and it ranged from (6.12-7.55)

The data regarding the overall acceptability of the product samples were statistically analyzed by using method of analysis of variance technique. The results are presented in table no. 16 (b). The calculated 'F' value of the treatments was found to be 17.424 while the table value of 'F' at 5 % probability level was 3.55

Since the calculated 'F' value exceeds the table value, therefore it is concluded that there was significant difference between the treatments.

It is noted from the above result that marked increase in overall acceptability was observed in T_1 sample containing 500 ml of whey. Thus the result reveals that the sample T_1 containing 500 ml of whey significantly higher overall

acceptability score than control sample T_0 and sample T_2 i.e. commercial soup. The result suggests that T_1 sample is best suited for overall acceptability of the product.

Effect of the treatments on total solids percentage of the product:-

The data given in the table 17(a) reveals that the control soup T_0 had total solids percentage of (16.65) and it ranged from (16.0-17.0) followed by T_1 with an average total solids percentage of (12.25) and it ranged from (12.0-12.5) and T_2 (11.35) ranged from (11.0-11.5).

The ANOVA table 17(b) reveals that the 'F' calculated value 14.623 was higher than the 'F' table value 3.55 at 5% probability level. Hence there was significant difference between the treatments.

It is observed that the total solids percentage of control sample T_0 was higher than the experimental soups. This difference is mainly because of presence of milk in control sample T_0.

Effect of the treatments on ascorbic acid (Vit.C) content of the product:

The data given in table no.18 (a) reveals that the average ascorbic acid (Vitamin C) content of T_0 was highest (10.62 mg/100gm) followed by T_1 (9.59mg/100 gm) and T_2(8.87mg/100gm).

It was statistically analyzed using the method of analysis of variance technique. Thus the result obtained are present in ANOVA table 18(b). The result presented in

ANOVA table shows that the calculated 'F' value 4.465 was higher than the 'F' table value 3.55 at 5% probability level.

It is noted that the control sample To was having significantly higher vitamin C content than the experimental sample. It is also noted that after heat processing the vitamin C content was significantly decreased due to the heat effect on vitamin C.

Effect of the treatments on protein percentage of the product:-

The data obtained from table no. 19 (a) reveals that the control soup T_0 had an average protein (3.34) percentage and range of (3.2-3.5) percentage. The treatment T_1 had an average protein percentage of (1.01) and range of (0.9-1.2). The treatment T_2 had an average protein percentage of (1.12).

The above data was statistically analyzed. The ANOVA table 19(b) reveals that the calculated F value 3.778 was higher than the table 'F' value 3.55 at 5% probability level. Hence it is concluded that there was significant difference between the treatments.

It may be noted that marked increase in protein % of T_0 (Control soup) was higher than the treatments T_1 and T_2 due to the milk containing in control soup

Effect of the treatments on lactose percentage of the product:-

The data given in table no. 20(a) reveals that the sample T_2 had an average lactose % of (7.3). The treatment T_1 had an average lactose % of (4.02) and range of (4.0-4.05). The treatment T_0 had an average lactose % of (3.79) and range of (3.6-3.9)

The product sample was statistically analyzed by method of analysis of variance technique. The calculated 'F' value of treatment was found to be 7.8 greater than table value of 'F' 3.55 at 5% probability level. Since the calculated 'F' value exceeds the table value therefore it is concluded that there was significant difference between the treatments.

It is noted from the above result that lactose % in commercial soup T_2 was significantly higher than T_0 and T_1 samples.

Effect of the treatments on Calcium content of the product:-

The data given in table no. 21(a) reveals that the average calcium content of T_0 was highest (163.7mg/100gm) followed by T_2(124mg/100gm) and T_1(79.3mg/100gm)

It was statistically analyzed using the method of analysis of variance technique. Thus the result obtained are present in ANOVA table 21(b) shows that the calculated 'F' value 11.038 was higher than 'F' table value 3.55 at 5% probability level.

It is noted that the control sample T_0 was having significantly higher calcium content than the experimental sample.

Cost of production of whey tomato soup:-

The cost was analyzed and compared in table 22(a), 22(b) and 22(c). The result reveals that the cost of 500ml pack of commercial soup is Rs. 25.00 whereas the cost of the control soup was estimated to be Rs. 17.04/ litre and the cost of whey soup was Rs. 10.04/litre. Thereby suggesting that whey tomato soup is cheaper and is cost effective so that it may reach to weaker sector of customers.

Chapter -6

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The entire experiment was replicate 10 times and to evaluate the product for their organoleptic, chemical and cost of the product were analyzed. The data obtained were statistically analyzed using the method of analysis of variance technique. The result obtained from different tests is summarized below.

Aroma:-

The result reveals that the experimental sample T_1 had higher aroma score (7.95) than the rest of the samples T_2 (7.68) and T_0 (6.9)and this can be attributed to the combination of whey and tomato juice.

Colour and Appearance:-

The result reveals that the experimental sample T_2 had higher colour and appearance score (7.94) than the rest of the samples T_1 (7.68) and T_0 (6.42) and this is due to the addition of beetroot juice powder for the colour enhancement in commercial tomato soup.

Consistency:-

The result reveals that the experimental sample T_2 had higher consistency score (7.57) than the rest of the samples T_1 (7.08) and T_0(6.91) . It may be due to appropriate amount of corn flour alongwith edible starch which gives better consistency than the control and whey soup.

Taste:-

The result reveals that the experimental soup T_1 had higher taste score (8.22) than the rest of the samples T_2(7.33)

and T_0 (6.62) and this can be attributed to the combination of whey and tomato juice. It may be due to added sugar and salt percentage in whey soup

Overall Acceptability:-

The result reveals that the experimental sample T_1 had higher overall acceptability score (7.985) than the result of the samples T_2 (7.935) and T_0 (6.745) and this can be attributed to the combination of whey and tomato juice. The higher overall acceptability score of T_1 is due to good mouth feel and aroma of the product.

Total Solids:-

The result reveals that the total solids of control soup T_0 was higher (16.65) than the rest of the experimental soups T_1 (12.25) and T_2 (11.35). The higher total solid percentage of T_0 (control sample) is may be due to the milk used in the control sample.

Vitamin C (Ascorbic Acid):-

The result reveals that the T_0 sample had an average vitamin C content of(10.62 mg/ 100 gm) than the rest of the samples T_1 (9.59) and T_2(8.87) . It is noted that after processing, there is a marked decrease in vitamin C content of the product. This is due to the heating effect that takes place during the processing. The vitamin C content was decreased from 28 mg/100gm of fresh tomato juice to 9.59 mg/100gm in final product.

Protein:-

The result reveals that the control sample T_0 had higher protein percentage (3.34) than the rest of the samples

T_1(1.01) and T_2(1.12). The higher protein percentage of control sample may be due to the milk used in control sample.

Lactose:-

The result reveals that the sample T_2 had higher lactose % (7.3) than the rest of the samples T_0 (3.79) and T_1 (4.02). The higher lactose percentage in whey soup T_1 in comparison to T_0 was may be due to the whey used in the sample.

Calcium:-

The result reveals that calcium content was highest in T_0 (163.7mg/100gm) than the rest of the samples T_1((79.3) and T_2 (124.0). The higher calcium content of T_0 (control sample) is may be due to the milk used in the control sample.

Economics of Production:-

The cost of production of whey tomato soup worked out to be Rs. 5.02/500gm of pack in comparison to control and commercial soup which is Rs. 8.52/500gm and Rs. 25/500gm respectively. This is due to the fact that in the experiment conducted milk has been substituted by whey and since whey is usually drained off as waste material it has negligible cost therefore, the cost of production is less.

Conclusion:-

It is therefore concluded that a good quality of tomato soup can be prepared by using whey from coagulated milk product namely Paneer, Chhana, Cheese etc.. This will be cost effective and will reach the weaker sector of consumer who are deprived of such delicious nutritive beverages. At the same time whey will be utilized, rather than be drained off in drains causing an increase in BOD level thereby polluting the environment.

Chapter-7

BIBLIOGRAPHY

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1. **Allum D. (1980).** " *Whey the International Scene*" Indian society of Dairy Technology 33(2) : 159

2. **Anon (1969).** " *Prospects of Increased Whey Utilization* " *as cited DSA, 1971,33 (9)*: 698

3. **Anon (1979).** " *Non meat soup bases save restaurant labour , offer single serving beverage alternative*" Food product Development 13 (4)24.

4. **Anon (1988).**"*Dairy ingredients , New generation*" Food trades review pp. 33-38

5. **Aneja,R.P. (1992).**" *Traditional dairy delicacies a compendum*".Dairy India, pp.371-386.

6. **Bensova L. (1979).** " *Experience with hydrolysed lactose products*" Prumyst Potrasin 30 (12) 669-697 as cited in Food Sc. Technology Abstract ,1980 12 (7) 173.

7. **Bandyopadhyay S; Mandal A.K. and Ghatek R.Z. (1997).**"*Studies on shelf life of whey Beverage*" Indian Journal Dairy Science ,50,3.

8. **BIS .(1971).**"*Guide for sensory evaluation of food*" Methods and evaluation card, part 11,Bureau of Indian standard Manak Bhawan,New Delhi.

9. **Bamba P.P.; Malik M. and Nambudripad (1972).**" *Preparation of whey based beverages*", Annual report, NDRI, Karnal pp 53

10. **Clark W.S.(1979).**"*Symposium on chemical and nutritional aspect of dairy wastes*" Journal of Agri. Food Chemistry27(4)553

11. **Dunkley W.L.(1997).**"*Update on whey processing products and uses*", Italian cheese journal 6(1) 1,3-8.

12. **Durham R.J.; Haungan J.A.; Siegh R.W. and Johnson R.L. (1997).**"*Whey fractionation and wheying off consequences*". Food Australia 49(10)460-465.

13. **Eckles C.H.; Combs W.B. and Macy H. (1961).** " *Milk and milk products*" Mc. Graw Hill Book Co.ed.61(1)96.

14. **FAO (1995)**"*Production yearbook*" Food and Agriculture organisation publication United Nation ,Rome ,Italy.

15. **Forsums E. and Hambraeus (1976).** "*Nutritional and biochemical studies of whey product*" Indian journal of Dairy science 60:370.

16. **Gandhi D.N.(1989).**"Whey utilisation for beverage production "Indian Dairyman 6:41-35.

17. **Ghosh.S.(1994).**"*Studies on the manufacture of instant mushrooms whey soup*" M.Sc Thesis NDRI Karnal and Indian journal Dairy Science,So,2,1997.

18. **Gillies M.T. (1974).**"*Whey processing and utilisation aspects*". Pub. Noyes data corporation, New Turkey Pg.-7.

19. **Glasser G; Jon-Vall R.E. and Kaplow M. (1972).** "*Tomato soup concentrate*" United State patent.

20. **Groves F.W. (1972).**"*An economic analysis of whey utilisation*" Bulletin No.48 University of wifcanjoin.

21. **Hanseen R.(1980).**"*There are no by -product in milk* " Nodeuopaeisk Majored,Trisskrift 46(12)1-3 as cited in food science technology abstracts.12(11):49(1980).

22. **Hedrick. T.I. (1969).** "*New and special Dairy Technology products and processes*" Dairy industries 34 (7)420-25,17.

23. **Hoffman F.(1961).**"*Treatise on the virtue and uses of whey*" Indian journal of Dairy science 13.139.

24. **Horton B.S.(1995).** "*Bulletin of International Dairy federation whey processing and utilization* " Bin308/1995.

25. **Hoogstraten and Van J.J. (1987).** "*Marketing of whey product A view from Europe*" (IDF) bulletin no. 212-17.

26. **IS 1479 (1961).** "*Methods of test for dairy industry . Part II chemical analysis of milk* " Burea of India, Manak Bhavan New Delhi.

27. **ISI (1981).** "*Handbook of Food analysis* ", Dairy products Indian standarad institute , New Delhi, part XI.,18,10.

28. **ISI 1479 (1962).** "*methods of test of dairy products part III Bacteriological analysis of milk*" Bureau of Indian standard, Manak Bhawan, New Delhi

29. **Jelen P.(1978).** "*The use of cheese whey and its components in human foods*". Food Technology, New Zealand 17(11): 23

30. **Kennedy J.P. (1985).** "*Utilization of whey*" Journal of Cultured Dairy products 20(1) : 13

31. **Khramtsov A.G. (1995).** "*Scientific and technical aspects of the efficient use of whey* "Vol. 57 No.12, P, 76-94.

32. **Khamrui K. and Rajorhia G.S. (1998).** *"Formulation of ready to serve whey based berevage."* Indian Journal of Dairy Sci 51, 6.88.

33. **Khamrui K. and Rajorhia G.S. (1988).** *"Making profit from whey"* Indian Dairyman, 50, (16) , 98 13-18.

34. **Knight O.S.; Smith N. and Mickee *J.B. (1972).*** *"Cheese whey disposal using* ***S. Fragilis*** *yeast"* culutre dairy Product Journal 1(2) 17-18.

35. **Kulkarni M.B.; Chavans I.G. and Belhe N.D. (1981).** *"Chemical composition of chakka whey"* Indian J. of dairy sci. 40: 65.

36. **Mann E. J. (1994).** *" Whey utilization"* Dairy Industries International 59(11); 16-17 and 56:18.

37. **Mathur B.N.; Shahani K.M.; Kilara A.(1978).** *"Utilization of whey as human food".* Cultured dairy product Journal 13(2) 7-12, 10 ref miff (1959) Lab

38. **Morr C.V. and Foegeding E.A. (1990).** *"Composition and functions of commercial whey and milk protein concentrate and isolates".* A status report, food technology 44: 110

39. **Prendergast K. (1985).** " *Whey drinks technology processing and marketing*" J. Dairy Sci technology 30 (4) :103-105.

40. **Puranik D.B.;Jain P. and Bandopadhyay S.(1997).** *"Value added commercial products from whey"* Indian Dairyman, Jan.pp.21-24.

41. **Puranik D.B.; Ramachandra H.G. and Rao (1996).** *"Potentiality of whey proteins as nutritional ingredients"* Indian Dairyman 1996 Vol. XL VIII No.11, P14-18.

42. **Ray S.C. and De S. (1953).** *"Composition of Whey"* Indian Dairyman vol. 5 (89-92).

43. **Rajorhia G.S. and Khamrui K. (1998).** "Making profit from whey" Indian Dairyman 50,6,98.

44. **Reigler M. (1980).** *"Preparation of fruit drinks and soups"* German federal Republic patent application.

45. **Riedel C.I.(1996).***"Whey a modern food"* part I duet sche milch wirts chaft 46(19) 1063-1071.

46. **Riddle N.I. and Chandler W.D. (1974).** *"Waste disposal of whey "* Abstract of paper presented in the whey utilization symposium" Canada PP. 94-102 cited in Food Science technical. Abstract 22: 2473.

47. **Roeper J. (1971).** "*Seasonal changes in composition of rennet and acid whey* " New Zealand Journal of dairy science technology 6 (3) : 122-114

48. **Singhleton A.D. (1974).** "*Food uses for whey products* " Abstract of paper presented at whey utilization symposiums, canada, pp 124-143 cited in food science, Technology Abstracat 1975. I (7) : 166.

49. **Singh S.; Ladkani B.G.; Kumar A. and Mathur B.N. (1994).** "*Whey utilization for ready to serve soup*" Indian journal of dairy sc. 47: 6 501-504.

50. **Snedecor G.W. and Cochran W.G. (1967).** In two-way classification statistical methods 6th edition 141.299

51. **Survey of Indian Agriculture (1999).** "Fruit and vegetable production in India." The Hindu publication. pp 22-23

52. **Whey product Institute U.S.A. (1983).** "*Whey and whey products*" In proceeding, 1982, whey product conference held Schaumbur, Ilainois, Oct, 21-22

APPENDICES

APPENDICES

REAGENTS FOR CHEMICAL ANALYSIS:--

1. Reagents for determination of ascorbic acid (Vit.C)

A. Standard ascorbic acid

i.) Pure ascorbic acid-20mg

ii.) oxalic acid-----1%

B. 2,6 - dichlorophenol-indophenole dye indicator

i.) Sodium salt of 2-6 - dichlorophenol - indophenol - 50 mg

ii.) Sodium bicarbonate -- 42mg

C. Oxalic acid solution 1 %

Calculation :--

$$\text{Ascorbic acid mg / 100 gm} = \frac{E \times V \times V_1 \times 100}{V_2 \times w}$$

where,

E = ascorbic acid equivalent of the dye in mg/ml
V = ml of the dye indicator used in the titration

V_1= volume to which the fruit juice is diluted

V_2= volume of the filtrate taken for the titration

W = weight or volume of the fruit juice initially taken for the determination.

2. Reagents for determination of protein-

A. Formaldehyde- (40%) neutral to phenolphthalein.

B. Potassium Oxalate solution - saturated.

C. Standard sodium hydroxide solution 0.1N.

D. Phenolphthalein indicator solution -0.5% in ethyl alcohol.

CALCULATION :--

Percent protein = V_1- Vml x 1.7

Where,

V_1= final burete reading (after adding neutral formaline)

V = initial burette reading

1.7= Pyne's constant

3. Reagents for determination of Lactose-

A. Fehling A solution

i.) $CuSO_4$. $5H_2O$ --- 34.639gm

B. Fehling B solution

i.) Potassium sodium tartrate(Rochelle salt)-173gm

ii.) NaoH-50gm

C. Methylene blue indicator Solution - 1% solution in water

D. Standard lactose solution.

i.) Lactose hydrate-1gm

CALCULATION:--

$$\text{Percent lactose} = \frac{F \times V \times 100}{T \times 1000 \times w}$$

Where,

F = corrected factor

T =Titre

V = Volume to which solution is made up in the volumetric flask.

W = Weight or volume of sample taken for the determination (1000 In The denominator is to convert mg to gm)

4. Reagents for determination of calcium: -

A. Diacid mixture

i.) Perchloric acid (60-62%)-100ml

ii.) Conc. HNO_3 (69-71%)--400ml

B. Ammonium hydroxide

C. Methyl Orange indicator

D. Dil. HCl

E. Ammonium Oxalate

F. Dil. H_2SO_4

G. Dil. $KMnO_4$

H. Standard potassium permanganate solution

CALCULATION :-

$$\text{Calcium mg/100gm} = \frac{V \times N \times 0.02 \times V_1 \times 100}{V_2 \times W}$$

where,

V=volume of $KMnO_4$ used

N= normality of $KMnO_4$ used

V_1=volume to which digested extract is diluted

V_2=volume of diluted extract taken for determination

W= weight of sample taken

5. Calculation for determination of total solids:-

$$\%\text{Total solid} = \frac{\text{weight of residue } (W_2-W)}{\text{weight of sample}(W_1-W)} \times 100$$

where,

W= Tare weight of the dish

W_1=Weight of the dish + sample

W_2=Weight of the dish + residue

ANOVA:-

d.f. = Degree of freedom

S.S. = Sum of squares

M.S.S. = Mean sum of squares